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DOCUMENT # DOE/RL 94-61

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SECTION 2 OF 2

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ATTACHMENT 6

DEVELOPMENT AND ANALYSIS OF REVISED FREQUENT-USE SCENARIO

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ATTACHMENT 6
DEVELOPMENT AND ANALYSIS OF REVISED FREQUENT-USE SCENARIO

1.0 INTRODUCTION

A revised frequent-use scenario has been developed by the Tri-Parties. This attachment to the sensitivity analysis defines the revised scenario and provides an assessment of how the existing evaluation in the Process Document changes under the revised scenario.

The implementation of the revised frequent-use scenario is based on the outcome of the Tri-Party Unit Managers meeting (February 22, 1995), in which the members described the revised scenario. This scenario was formalized in an information sheet and delivered to the Hanford Advisory Board following the meeting. A copy of the information sheet is included as Exhibit A.

In the main text of the sensitivity analysis, a range of exposure scenarios are examined to determine how the baseline evaluation in the Process Document would change under differing exposure scenario assumptions. This attachment to the sensitivity analysis examines how the baseline evaluation in the Process Document would change under the revised frequent-use scenario introduced by the Tri-Parties.

This attachment to the sensitivity analysis contains the following additional sections:

Section 2.0 - Exposure Scenario Development
Section 3.0 - Summary of Technical Alternatives
Section 4.0 - Detailed Analysis of Technical Alternatives
Exhibit A - Tri-Party "100 Area Cleanup Information Sheet"
Exhibit B - Revised Input for the Summers Method Analytical Model

2.0 EXPOSURE SCENARIO DEVELOPMENT

The 100 Area Cleanup Information Sheet that was recently presented to the Hanford Advisory Board states that "In all instances the goal of the cleanup will be completed to a level that will not preclude any future use due to Hanford contaminants." This statement was made in the context of being a proposal for discussion by the public for interim action high priority liquid waste disposal sites at the 100-BC-1, 100-DR-1, and 100-HR-1 Source Operable Units. The details of how cleanup levels would be implemented to meet this goal are provided below.

2.1 PROTECTION OF HUMAN HEALTH

Soils would be remediated to protect human health. The regulatory basis for human health protection PRG are as follows:

- State of Washington *Model Toxics Control Act* Method B for organic and inorganic chemical constituents in soil to support unrestricted (residential) use.

- Draft EPA and Nuclear Regulatory Commission proposed standard of 15 mrem/yr in soils above background for radionuclides for human health.

  The U.S. Environmental Protection Agency is proposing standards (40 CFR 196) for the remediation of soil, groundwater, and surface water at sites contaminated with radioactive material that will allow these sites to be released for public use. The proposed standard will limit radiation doses from contaminated sites to 15 mrem/yr above natural background levels for 1,000 years following cleanup. The 15 mrem/yr proposed standard corresponds to an ICR of 3 x 10^{-4}, based on the following assumptions:

  - The site would be used in the future for residential use
  - Residents are potentially exposed for 350 days/year for 30 years
  - "All potential pathways" are considered in assessing exposure to future residents (the exposure pathways are specified in the proposed rule, but are described in the Background Information Document.

  The 1,000 year time frame is intended to ensure that the standard accounts for decay of radionuclides to isotopes that are more highly radioactive. The rationale for the 115 mrem/yr standard is that if falls within the range of other radiation protection standards promulgated by EPA. Prior radiation protection standards correspond to increased cancer risks of 10^{-2} to 10^{-4}.

  The 15 mrem/yr standard is applicable to an entire site, including soils, structures, surface water, and air. Cleanup standards for groundwater are considered separately from these media. By limiting exposure levels to 15 mrem/yr above background, EPA acknowledges that background varies from site to site. As a result, radionuclide measurement techniques need to be able to distinguish site contamination from naturally-occurring radionuclides. According to the proposed rule, EPA in conjunction with the

U.S. Department of Energy and the Nuclear Regulatory Commission are developing guidelines for background determination.

For the purpose of the FFS, the point of compliance for protection of human health is assumed to be 4.5 m (15 ft) below the existing ground surface for inorganic and organic contaminants (MTCA cleanup levels) and radionuclides (15 mrem). This is consistent with the MTCA regulation summarized below.

> "For soil cleanup levels based on human exposure via direct contact, the point of compliance shall be established in the soils throughout the site from the ground surface to fifteen feet below the ground surface. This represents a reasonable estimate of the depth of soil that could be excavated and distributed at the soil surface as a result of site development activities [WAC 173-340-740(6)(c)]."

2.2 PROTECTION OF ECOLOGICAL RECEPTORS

As described in the Process Document, the protection of ecological receptors is assumed to be consistent with, and satisfied by, the protection of human health.

2.3 PROTECTION OF GROUNDWATER AND THE COLUMBIA RIVER

The protection of groundwater and the Columbia River has been considered under two cases.

- Protection of groundwater such that contaminants remaining in the soil after remediation do not result in an impact to groundwater that could exceed Maximum Contaminant Levels under the *Safe Drinking Water Act*. This applies to waste sites where groundwater has not been impacted.

- Protection of the Columbia River such that contaminants remaining in the soil after remediation do not result in an impact to groundwater and, therefore, the Columbia River that could exceed the Ambient Water Quality Criteria under the *Clean Water Act* for consumption of fish. This applies to sites where groundwater has already been impacted.

  Establishing the protection of the Columbia River PRG requires site-specific modeling. The analysis of the revised frequent-use scenario is based on the first case (assumption that groundwater has not been impacted). The modeling required to support the second case (groundwater has been impacted) will be developed during remedial design.

The Summers Method analytical model was used in the Process Document and Sensitivity Analysis to develop protection of groundwater PRG. Because these documents have been produced and reviewed by the Tri-Parties, a number of modifications to the model input parameters have been made. The revised model has been incorporated as part of the revised frequent-use scenario. An explanation of how the model was revised is included as Exhibit B.

2.4 PRELIMINARY REMEDIAL GOALS

The PRG for the revised frequent-use scenario are inherently waste site specific. The 15 mrem/yr dose above background is based on the cumulative contributions from individual radionuclides. The mrem contribution from cesium may differ from site to site. The protection of groundwater and the Columbia River PRG will also vary based on site-specific physical features, analysis of past practice, and soil chemistry. For purposes of analysis presented in this attachment, the PRG for the modified frequent-use scenario are assumed to be representative of the revised frequent-use scenario because they are both based on residential type land surface use and the use of the modified input parameters in the Summers Model lessens the influence of the protection of groundwater criteria.

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3.0 SUMMARY OF TECHNICAL ALTERNATIVES

The alternatives developed in the current FFS were established by the screening performed in the *100 Area Feasibility Study Phases 1 and 2* (DOE/RL 1993a). The phase 1 and 2 screening defined potentially applicable general response actions for 100 Area waste sites. This screening was performed before the recent LFI and QRA efforts, which provide additional data to further assess the applicability of these general response actions.

In the Process Document, alternatives consistent with the following general response actions were developed:

- No Action
- Institutional Controls
- Containment
- Removal/Disposal
- In Situ Treatment
- Removal/Treatment/Disposal

Initial consideration was given to the alternatives to ensure that the actions would provide adequate protection under the given land-use scenario. It was determined that the alternatives, as developed, would allow protection under an occasional-use scenario. The alternatives were subjected to an additional site-specific applicability screening. For instance, it was established that the in situ vitrification (ISV) technology could only effectively contain contamination to a depth of 5.7 m (19 ft) below the ground surface. Therefore, the ISV Alternative was not analyzed in the detailed analysis for sites with contamination at a depth of greater than 5.7 m (19 ft). As stated in the NCP section 300.430(e)(9)(i), the detailed analysis shall be conducted on the limited number of alternatives that represent viable approaches to remedial action after evaluation in the screening stage. The detailed analysis documented in the Process Document evaluates the viable alternatives against the nine CERCLA evaluation criteria.

Because the revised frequent-use scenario has been established, the effectiveness of the viable alternatives must be considered again. Because the new scenario is based on cleanup that does not preclude any future use, remedial action that limits access or land use would not be compatible with the new scenario. In Situ Treatment Alternatives (e.g., ISV and grouting), as well as containment, are no longer considered viable alternatives because they preclude some types of future use. Additionally, the Institutional Controls Alternative was not evaluated in detail in the Process Document because it was not considered applicable for any of the waste site groups. Therefore, the only alternatives evaluated in detail are No Action, RD and RTD.

4.0 DETAILED ANALYSIS OF TECHNICAL ALTERNATIVES

Section 5.0 of the Process Document presents a detailed analysis of the candidate remedial alternatives with respect to seven of nine CERCLA evaluation criteria. The seven criteria evaluated include the following:

Threshold Criteria

- Overall protection of human health and the environment
- Compliance with ARAR

Balancing Criteria

- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, and volume through treatment
- Short-term effectiveness
- Implementibility
- Cost.

The two remaining criteria, state acceptance and community acceptance, will be considered after regulatory and public comment on the proposed plan and FFS documents.

An evaluation of the viable alternatives, for the revised frequent-use scenario is described in the following sections. The alternatives are examined against the CERCLA criteria by evaluating those elements of remedial action that are significantly impacted by a change in exposure scenario.

The potential cultural and ecological resource impacts discussed in the Process Document and the Sensitivity Analysis were reviewed for applicability to the revised frequent-use scenario described in this attachment to the Sensitivity Analysis. These reviews identified that a change from an occasional-use scenario to a frequent-use scenario would result in an incremental change in excavation area and volume and this incremental change could potentially impact cultural and ecological resources. Other secondary factors, such as noise and utilities, could also change but are short-term and of a minor nature compared to the cultural and ecological potential impacts. The revised frequent-use scenario integrates various remediation goals (i.e., protection of human health, groundwater, and the Columbia River) that were included in the different exposure scenarios analyzed in the Sensitivity Analysis. This new concept does not introduce any new issues that have not been discussed in the Process Document and Sensitivity Analysis.

4.1 EVALUATION OF CRITICAL PARAMETERS

The critical parameters include EV, CV, duration of remedial action, percent of material that is treatable, and cost. The reason these parameters are significantly impacted by a change in exposure scenario is primarily because of their relationship to PRG.

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The modified frequent-use scenario evaluated in the Sensitivity Analysis is considered appropriate to estimate the relative volumes, costs, and durations for the revised frequent-use scenario. The modified frequent-use scenario considers frequent-use of the first 4.5 m (15 ft) of soil and is based on a target risk of 1×10^{-6} for radionuclides and inorganic and organic contaminants. This approach is generally consistent with MTCA values for nonradionuclides. The 1×10^{-6} target risk for radionuclides is more conservative than the 15 mrem values that are estimated to be comparable to a 1×10^{-4} risk.

The modified frequent-use scenario does not consider contamination below 4.5 m (15 ft) at all vadose zone depths. However, the new scenario does consider contaminants at depth; the protection of groundwater is addressed through the application of the revised Summers model. A preliminary assessment was conducted to determine how the revised model changed excavation depths at the four representative sites. The results indicate that the application of the revised summers model would not drive the excavation (at the four representative sites) deeper than 4.5 m (15 ft). Therefore, the volumes and costs of the modified frequent-use scenario are used as substitutes for the revised frequent-use scenario. The following analysis is based on this substitution.

The critical parameters are contaminated and excavated volume, duration, percent treatable, and cost. Each parameter is discussed in the context of comparing the revised frequent-use scenario with the baseline scenario.

4.1.1 Contaminated and Excavated Volume

The CV is the quantity of material that must be addressed by the remedial action. The revised frequent-use scenario results in a 26% decrease in volume relative to the baseline scenario. The EV is the quantity of material that must be handled to complete the remedial action. The revised frequent-use scenario represents a 41% decrease in volume relative to the baseline scenario.

4.1.2 Duration

Duration is the amount of time required to complete the remedial action. This is an important parameter when considering short-term risks to workers from industrial hazards and exposure to contaminants. The revised frequent-use scenario potentially results in a decrease in remedial action duration.

4.1.3 Percent Treatable

Percent treatable is the percentage of the contaminated material that can be treated by soil washing. The percentage represents the effectiveness of the treatment alternative under a given exposure scenario. Without specific PRG, the effectiveness can not be quantified at this time; however, as PRG become more stringent, the effectiveness (percent treatable) decreased.

4.1.4 Cost

The costs associated with the revised frequent-use scenario cannot be calculated directly because the PRG are not available. Revised scenario costs have been estimated by comparing the modified frequent-use costs to the FFS. The revised scenario costs for the RD and RTD Alternatives are estimated to be approximately 30 % less than the baseline scenario, as developed from the 100 area-wide estimate costs presented in the sensitivity analysis.

4.1.5 Cultural Resources

The revised frequent-use scenario is anticipated to result in a decrease in volume of excavated material compared to the volume of excavation in the Process Document. As a result, the cultural resources concerns will either be of similar impacts as previously described or will be less of an impact. The No Action Alternative will remain the same as evaluated before in that cultural resources will not be disturbed but with the contamination left in place, what cultural resources exist at the site will remain with the contaminated material. The frequent-use scenario is incompatible with the CAP and in-situ treatment Alternatives. The RD and RTD Alternatives require an equal amount of volume to be disturbed but with the RTD Alternative more area would be required for treatment activities.

4.1.6 Ecological Resources

The footprint of the revised frequent-use scenario is anticipated to be equal to or smaller than the footprint estimated in the Process Document. Therefore, the assessment performed in the Process Document and Sensitivity Analysis is applicable to the revised frequent-use scenario. The No Action Alternative will not disturb additional ecological resources but the No Action Alternative and the CAP and In Situ Treatment Alternatives will not make the land available for future uses. As a result RD and RTD are the options to be considered with respect to long term benefits. The RTD Alternative would potentially impact a larger surface area due to the additional staging areas required for treatment equipment as well as material stockpiling, segregation, and handling.

4.2 IMPACT ON THE EVALUATION OF THE CERCLA CRITERIA

This section identifies the impacts of changing the exposure scenario on the evaluation of the CERCLA criteria, as presented in the Process Document. The impacts are assessed for only those alternatives considered viable under the new scenario. The viable alternatives are No Action, RD, and RTD.

4.2.1 Overall Protection of Human Health and the Environment

As with the other exposure scenarios, the No Action Alternative would not be protective of human health and the environment because contamination remains at the site. The RD and RTD Alternatives would provide overall protection of human health and the environment at completion of the remedial action based on contaminant removal.

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4.2.2 Compliance with ARAR

As with the other exposure scenarios, the No Action Alternative would not meet all of the applicable or relevant and appropriate requirements identified for remediation of the waste sites. The RD and RTD Alternatives would comply with ARAR.

4.2.3 Long-Term Effectiveness and Permanence

The No Action Alternative would not be effective over the long term since the threat to human health and the environment is not adequately mitigated. The RD and RTD Alternatives would be effective over the long term because contamination is removed from the waste site and placed in an engineered disposal facility for long-term management.

4.2.4 Reduction of Toxicity, Mobility, and Volume through Treatment

The No Action Alternative would not provide reduction of toxicity, mobility, or volume. The RD and RTD Alternatives both continue to provide some reduction in mobility by placing the contaminated material in an engineered disposal facility for long-term management. The RTD Alternative includes the most significant level of treatment and may reduce the volume of contaminated material requiring disposal.

4.2.5 Short-Term Effectiveness

The No Action Alternative would not result in adverse impacts to workers during implementation because No Actions would be performed; however, the existing threats to human health and the environment would remain. The RTD Alternative would result in risk to workers from the treatment process and require more time to implement. The RD Alternative would require less time to implement than the RTD Alternative and present less short-term risk to workers.

4.2.6 Implementibility

The RD Alternative is fully implementable for each exposure scenario. The technology is proven, established, and readily implementable. The RTD Alternative is impacted by the performance limitations of technologies, such as soil washing. As PRG become more stringent, the ability of soil washing to treat contaminants decreases, rendering the RTD Alternative less implementable. The amount of soil that can be treated is the best indicator of the Implementibility of soil washing. The No Action Alternative would be easy to implement because No Actions would be required; however, the potential threats posed by the waste site would remain.

4.2.7 Cost

Section 4.1.4 establishes cost adjustment factors based on the results of the sensitivity analysis. These factors can be applied to the current cost estimates in the FFS to ascertain a new cost estimate suitable to compare alternatives under the revised frequent-use scenario.

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EXHIBIT A

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February 22, 1995

To: Hanford Advisory Board
From: Tri-Party Agencies
RE: 100 Area Clean Up Information Sheet

The information below concerns the cleanup activities in the 100 Area. This information is being faxed to foster discussions during Thursday afternoon's 100 Area discussion. There are two pages to this fax.

Over the last several months, the agencies have been working to develop cleanup plans (i.e., proposed plans) for the first three operable units in the 100 Area. These units are 100-BC-1, 100-DR-1, and 100-HR-1. The proposed plans will focus on the radioactive liquid waste disposal sites, such as cribs, trenches, and retention basins. The solid waste burial grounds and septic tanks associated with these areas will be covered in subsequent plans.

There are approximately 30 waste sites that will be addressed in these plans. In earlier discussions with the board the agencies shared that the preferred alternative for the 100 Area as a remove and dispose option. The discussions have focused on issues such as cleanup levels, timing for the cleanup, how reactor removal influences cleanup decision, and early cleanup.

The agencies have agreed on cleanup levels for these waste sites. The *State of Washington Model Toxic Control Act* (MTCA) will be used to generate chemical/metals cleanup levels. The agencies are considering the use of the proposed EPA and NRC standard of 15 mrem above background for the radioactive component cleanup standard; this equates to a 10^{-4} cleanup level under CERCLA. This also is consistent with EPA risk assessment methodology and the Hanford Risk Assessment Methodology. For sites that have impacted groundwater, the Freshwater Quality Criteria standards for protection of the Columbia River will be used to establish cleanup levels. In sites that have not impacted groundwater, the chemical specific Maximum Contaminant Levels under the *Safe Drinking Water Act* will be used.

In regard to the timing of clean up, the agencies believe that a phased approach should be used. Sites will be prioritized by size and location during the remedial design phase with an emphasis on sites that have impacted groundwater. The remedial emphasis on sites that have impacted groundwater. The remedial design phase occurs after the record of decision has been issued. Those sites that are in close proximity (50 m has been discussed) of the reactor are proposed to be deferred for cleanup until such time that the reactors are removed.

Removal of contaminants at deep sites will be determined on a case-by-case basis. Where appropriate, decay of radionuclides will be evaluated and balanced against protection of human health and the environment, costs, sizing of the ERDF, worker safety, disturbance of environmental and cultural resources, the use of institutional controls, and long-term monitoring considerations. In all instances the goal of the clean up will be completed to a level that will not preclude any future use because of Hanford Site contaminants.

The three agencies have been working with the Department of Energy Headquarters on a new project called the Streamline Approach for Environmental Restoration (SAFER). This approach combines the data quality objective method with the observational approach. The agencies plan on using this process to do remedial design and remedial action planning to begin remedial action at several key sites in the 100-BC area this summer. The three agencies will be involved in up front planning for this project and will keep the board and affected Indian Tribes apprised of the progress of this project.

The schedule for the first three cleanup plans is to have the proposed plans ready for the board at the April meeting. The agencies expect to begin public comment by mid-April with record of decision being issued this summer.

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EXHIBIT B

REVISIONS TO THE SUMMERS METHOD ANALYTICAL MODEL

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This exhibit is a summary of revisions to the Summers model presented in the 100 Area Focused Feasibility Study for estimating contaminant concentrations in soil that are protective of groundwater protection values. The only changes made in this version of the model are:

- Use of a recharge rate to groundwater that better reflects hydrological conditions at the Hanford Site; and

- Reevaluation of soil/water distribution coefficients (K_d) for inorganic constituents.

Review of available literature indicated that K_d values for 11 contaminants should be revised. All other parameters have remained unchanged from the version of the model originally published in the Focused Feasibility Study

The recharge rate to groundwater originally used in the Summers model (10 cm/year) is too conservative compared to other values typically observed at the Hanford Site. The value used in the revised model (0.2 cm/year) is based on the results of long-term lysimeter studies performed at the Hanford Site (Routson, R.C. and V.G. Johnson. 1990. Recharge Estimations for the Hanford Site 200 Areas Plateau. *Northwest Science*. 64(3): 150-158).

The revised protection of groundwater PRG is summarized in the attached table. Documentation of the revised modeling assumptions and calculations is also attached.

PRGs Protective of Groundwater Quality

	Values Originally in FFS	Values Based on Revised Summers Model	Units
Am-241	31	3,756	pCi/g
C-14	18	2,320	pCi/g
Cs-134	517	62,600	pCi/g
Cs-137	775	93,900	pCi/g
Co-60	1,292	156,500	pCi/g
Eu-152	20,667	2,504,000	pCi/g
Eu-154	20,667	2,504,000	pCi/g
Eu-155	103,000	12,520,000	pCi/g
H-3	517	66,282	pCi/g
K-40	145	17,528	pCi/g
Na-22	207	25,040	pCi/g
Ni-63	46,500	5,634,000	pCi/g
Pu-238	5	5,008	pCi/g
Pu-239/240	4	3,756	pCi/g
Ra-226	0.03	6,260	pCi/g
Sr-90	129	15,650	pCi/g
Tc-99	26	3,314	pCi/g
Th-228	0.1	50,080	pCi/g
Th-232	0.01	6,260	pCi/g
U-234	5	626	pCi/g
U-235	6	751	pCi/g
U-238	6	751	pCi/g
Antimony	0.002	5	ug/g
Arsenic	0.01	94	ug/g
Barium	258	15,650	ug/g
Cadmium	1	94	ug/g
Chromium	0.03	12,520	ug/g
Lead	8	282	ug/g
Manganese	13	1,565	ug/g
Mercury	0.3	38	ug/g
Zinc	775	93,900	ug/g
Aroclor 1260	1	166	ug/g
Benzo(a)pyrene	6	689	ug/g
Chrysene	0.01	25	ug/g
Pentachlorophenol	0.3	33	ug/g

ug/g = mg/kg

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Revised Summers Model Calculations
February 21, 1995

Objective

Estimate the concentrations of constituents in vadose zone which will elevate groundwater concentrations above allowable levels. The following presents revisions to the original April 1994 model, which is presented in the Process Document.

Method

Allowable constituent concentrations are calculated using the Summers Model, which is rearranged to solve for concentration in soil from concentration in groundwater. The rearranged model is presented below:

$$C_p = \frac{C_{gw}(Q_p + Q_{gw}) - Q_{gw} C_i}{Q_p}$$

where

C_{gw}	=	Allowable concentration in groundwater (pCi/L or ug/L)
Q_p	=	Volumetric flow rate to groundwater (ft^3/day); calculated as A_p x q
A_p	=	Horizontal area of contamination (ft^2)
q	=	Recharge rate (ft/day)
Q_{gw}	=	Groundwater flow rate (ft^3/day); calculated as V x h x w
V	=	Darcy velocity in groundwater (ft/day); calculated as K x i
K	=	Hydraulic conductivity of aquifer (ft/day)
i	=	Hydraulic gradient in aquifer (ft/ft)
h	=	Thickness of zone of mixing in aquifer (ft)
w	=	Width of zone of mixing in aquifer (site width) (ft)
C_i	=	Initial concentration in groundwater (assumed to be zero) (pCi/L or mg/L)

Concentration in soil is calculated from C_p (leachate concentration) as follows:

$$C_s = K_d C_p$$

where

C_s	=	Concentration in soil (pCi/g or ug/g)
C_p	=	Concentration in leachate (pCi/mL or ug/mL)
K_d	=	Distribution coefficient (mL/g)

For contaminants where the K_d value is zero, concentrations in soil are calculated as follows:

$$C_s = C_p\left(\frac{m}{d}\right)$$

where

m = volumetric moisture content (unitless)
d = dry soil density (g/mL)

Distribution coefficients for radionuclides and inorganics are estimated from a review of the literature (attached). Distribution coefficients for organics are estimated as follows:

$$K_d = K_{oc} f_{oc}$$

where

K_{oc} = Soil organic carbon constant (mL/g)
f_{oc} = Fraction of organic carbon in soil

K_{oc} values were unchanged from the FFS. The value for f_{oc} was assumed to be 0.1 percent (f_{oc} = 0.001), which was unchanged from the FFS.

Parameters

PARAMETER	SYMBOL	VALUE	SOURCE
Allowable concentration in groundwater	C_{gw}	Contaminant specific	Maximum Contaminant Limits (MCL) for nonradioactive contaminants; Derived Concentration Guides (DCG) for radionuclides
Volumetric flow to groundwater	Q_p	11.5 ft³/day	A_p x q; A_p = 640,000 ft² (see below), q = 1.8 x 10^{-5} ft/day (see below)
Horizontal area of contamination	A_p	640,000 ft²	Assumed surface area of 116-C-5 retention basin, based on dimensions of 800 x 800 ft
Recharge rate	q	1.8 x 10^{-5} ft/day	Varies from site to site. Assumed value of 0.2 cm/yr (Routson and Johnson 1990)
Groundwater flow rate	Q_{gw}	7,200 ft³/day	V x h x w; V = 0.3 ft/day (see below); h = 30 ft (see below); w = 800 ft (see below)
Darcy velocity in groundwater	V	0.3 ft/day	K x i; K = 100 ft/day (see below); i = 0.003 ft/ft (see below)
Hydraulic conductivity of the aquifer	K	100 ft/day	Hydraulic conductivity of the Ringold Formation (DOE-RL 1993b)

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PARAMETER	SYMBOL	VALUE	SOURCE
Hydraulic gradient of the aquifer	i	0.003 ft ft	DOE-RL, 1993b
Thickness of the mixing zone in the aquifer	h	30 ft	N Area Report
Width of the mixing zone	w	800 ft	Assumed to be the site width (value for 116-C-5 retention basin)
Volumetric moisture content	m	0.09	Soil moistures average 5 (w/w) or 9% by volume (DOE-RL 1994)
Dry soil density	d	1.7 g/mL	Based on value of ~110 lb/ft^3

References

DOE-RL, 1993a, 100 Area Feasibility Study Phases 1 and 2, DOE/RL-92-11, Draft B, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1993b, *Limited Field Investigation Report for the 100-BC-5 Operable Unit*, DOE/RL-93-37, Draft A, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1994, *100 Area Excavation Treatability Study Report*, DOE/RL-94-16, Decisional Draft, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

EPA, 1986, Superfund Public Health Evaluation Manual, U.S. Environmental Protection Agency.

Routson, R. C. and V. G. Johnson, 1990, Recharge Estimations for the Hanford Site 200 Areas Plateau, *Northwest Science*, 64(3): 150-158.

Distribution Coefficients for Inorganic Contaminants in Soil

The distribution coefficient (K_d) is an empirical parameter that represents the tendency for a chemical substance to adsorb to soil. Typically, it is measured in the laboratory as the ratio of concentration in soil (C_s) to concentration in water (C_w), at equilibrium, as shown below:

$$K_d = \frac{C_s}{C_w}$$

The greater the extent of adsorption in soil, the greater the value of K_d.

Values for K_d can then be used in models to quantify the amount of contaminant in soil that can leach to groundwater. The K_d values measured for an individual substance can vary substantially based on differences in soil properties. For example, the range of K_d values for plutonium and zinc measured in different soils can span four orders of magnitude (Dragun 1988; Baes and Sharp 1983). The variables affecting K_d include the relative abundance of different cations and anions in soil, soil pH, redox potential, cation exchange capacity, and organic matter content (Dragun 1988; Barney 1978).

Ideally, the K_d value to be used to model leaching potential in Hanford Site soils should be based on site-specific measurements. However, sole reliance on site-specific measurements generally is not feasible. An alternate approach to developing K_d values for modeling is to (1) identify the range of K_d values measured in Hanford Site soils, or under conditions similar to those encountered in Hanford Site soils and (2) select a value that provides a conservatively reasonable estimate of contaminant leaching to groundwater. These selected values then can be used to develop preliminary remediation goals (PRG) in soil.

Methodology

Several studies have compiled K_d values for a variety of soil, sediment, and leachate conditions at the Hanford Site. As discussed previously, these values generally span a range depending upon soil and leachate (liquid waste stream) conditions. These conditions include varying combinations in soils and leachate of:

- High or low salt concentrations
- High or low organic matter concentrations
- Acid (low pH) or neutral/basic (moderate to high pH) conditions

The approach for selecting conservatively reasonable values for K_d involved evaluating the characteristics of Hanford Site soils, and identifying the K_d value corresponding most closely to those characteristics. The hierarchy of data used to select K_d values was to use Hanford-specific data in preference to more general compilations of K_d values in the literature. The selected values were compared with the range of general literature values. Finally, uncertainties in the data were discussed to support the selected K_d value.

Hanford Soil Characteristics

For purposes of selecting K_d values from the literature, most Hanford Site soils are characterized as low salt, low organic matter content with neutral to basic pH (Serne and Wood, 1990). Hanford Site soils typically are sandy with very little organic carbon content (Ames and Serne 1991). Soil pH measured in 100 Area soils range from 6.5 to 7.66. Total organic carbon concentrations range from 600 to 1,640 ppm (DOE-RL 1994).

K_d Data Sources

The principal sources of information on Hanford-specific K_d values consulted in this analysis were Ames and Serne, 1991 and Serne and Wood, 1990. These references provided information on most of the radionuclide and nonradioactive inorganic contaminants in soil in the 100 Area. Ames and Serne (1991) provided ranges of K_d values for different waste stream characteristics (high/low dissolved solids, high/low organic content, low/neutral to high pH); these parameters being more variable than soil characteristics at the Hanford Site. Ames and Serne also recommended conservative estimates of K_d values for use in modeling contaminant leaching (WHC 1990). Ames and Serne (1991) recommended K_d values for each contaminant of potential concern, except for C, As, Sb, Th, and Ra. Serne and Wood (1990) summarized available information on K_d values, and identified changes in K_d values with changing conditions in soil. These references did not reveal information on K_d values for thorium and arsenic. Information on these two contaminants in soil was developed from the range of K_d values compiled by Baes and Sharp (1983). Baes and Sharp presented ranges of K_d values for 222 agricultural soils and clays between pH 4.5 and 9. The K_d values presented in these sources are summarized in Table 1.

Selected K_d Values

The K_d values selected for modeling contaminant concentrations leaching to groundwater are summarized in Table 1. Uncertainties in the data for selected contaminants are discussed below.

Cesium. Ames and Serne (1991) recommended a K_d of 50 from values ranging from 50 to 3,000. Baes and Sharp (1983) cite a range from 10 to 52,000, with a geometric mean of 1,100. According to Serne and Wood (1990), the available data indicate that a minimum value of 200 is reasonable for ambient conditions in soil at the Hanford Site (near neutral pH, low dissolved solids concentrations and low organic matter content); the value of 200 was selected as a K_d for cesium based on data evaluated by Serne and Wood (1990).

Plutonium. Ames and Serne (1991) recommended a K_d of 25, with a range from 100 to 2,000. Baes and Sharp (1983) cite a range from 11 to 300,000, with a geometric mean of 1,800. Serne and Wood (1990) cite studies in which plutonium sorption in a pH range from 4 to 8.5 was high, with $K_d > 1,980$. Based on the available data, Serne and Wood (1990) recommended a range of K_d values from ~100 to 1,000 for ambient soil conditions at the Hanford Site. Data reviewed by Serne and Wood appear to show similarities in the behavior of plutonium and americium in soil, while Ames and Serne recommend a K_d of 200 for americium. Based on this range of information, a K_d of 200 was selected for plutonium.

Uranium. Ames and Serne (1991) recommend a K_d of 2 for uranium from a range from 2 to 2,000. Baes and Sharp (1983) cite a range from 10.5 to 4,400, with a geometric mean of 45. Serne and Wood (1990) suggest that uranium would sorb poorly to soil under neutral and basic conditions, and concluded that additional data were required to support a recommended K_d value. Uranium has been detected in groundwater at 100 Area sites, suggesting that it has some mobility in soil. While it is likely that K_d values are higher, a K_d of 2 was selected for modeling contaminant leaching.

Thorium. There have been no estimates of K_d developed for thorium at the Hanford Site. The range of literature values cited by Baes and Sharp (1983) is from 2,000 to 510,000. Values for K_d at a pH of 8.15 in medium sands (40 - 130) and very fine sands (310 - 470) (Yu et al. 1993) are likely to be appropriate for soil conditions at the Hanford Site. The higher K_d values appear to be associated more with silty-clay soils (Ames and Rai 1978). The K_d values for thorium are lower with low soil pH. A conservative estimate of 100 was selected as a K_d for thorium in Hanford Site soils.

Radium. There have been no estimates of K_d developed for radium at the Hanford Site, and there were no data cited in Baes and Sharp (1983). Yu et al. (1993) compiled data indicating K_d values at acidic pHs (2 - 6) ranging from 0 to 60, and K_d values at neutral/basic pHs (7 - 7.7) ranging from 100 to 2,400. Data summarized in Ames and Rai (1978) indicate K_d values at neutral/basic pHs ranging from 214 to 354. A conservative estimate of 200 was selected as a K_d for radium in Hanford Site soils.

Arsenic. There have been no estimates of K_d developed for arsenic at the Hanford Site. The range of values cited in the literature are 1 to 8.3 for As III (geometric mean of 3.3) and 1.9 to 18 for As V (geometric mean of 6.7) (Baes and Sharp 1983). A value of 3 was selected as a K_d for arsenic in Hanford Site soils.

Antimony. Estimates of K_d for antimony at the Hanford Site range from 0 to 40 (Ames and Serne 1991). Studies of the soil chemistry and observed mobility of antimony-containing wastes have resulted in K_d values ranging from <1 to >1,000 (Ames and Rai 1978). A value of 1 was selected as a K_d for antimony in Hanford Site soils.

Chromium. The mobility of chromium in soil will vary greatly with valence. The Cr VI is highly mobile in soil, and has been estimated to have a K_d of zero (Ames and Serne 1991). However, Cr VI is readily reduced in soil to Cr III by the presence of ferrous ion and organic matter. A minor amount of Cr III can be oxidized to Cr VI through the presence of manganese oxides in soils and sediments (Thorton et al. 1994). A suggested K_d value for Cr III = 200 mL/g.

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Table 1. Summary of Revised Kd Values for Summers Model used in the 100 Area FFS

Contaminants of Potential Concern	Kds in the FFS	Revised Kd value	Source for Revised Kd value	Ames and Serne, 1991 (a)		Baes and Sharp, 1983 (c)	
				Recommended Value	Range	Geometric mean	Observed Range
Am-241	200	200	Ames and Serne, 1991	200	100-500	810	1.0-47,230
C-14	**0.05**	**0**	Serne and Woods, 1990				
Cs-134	50	50	Ames and Serne, 1991	50	50-3,000	1,110	10-52,000
Cs-137	50	50	Ames and Serne, 1991	50	50-3,000	1,110	10-52,000
Co-60	50	50	Ames and Serne, 1991	50	10-3,000	55	0.2-3,800
Eu-152	200	200	Ames and Serne, 1991	200	100-500		
Eu-154	200	200	Ames and Serne, 1991	200	100-500		
Eu-155	200	200	Ames and Serne, 1991	200	100-500		
H-3	**0.05**	**0**	Serne and Woods, 1990				
K-40	4	4	Ames and Serne, 1991			5.5	2.0-9.0
Na-22	4	4	Ames and Serne, 1991	4	1-30		
Ni-63	30	30	Ames and Serne, 1991	4	1-30		
Pu-238	**25**	**200**	Serne and Woods, 1990	25	100-2,000	1,800	11-300,000
Pu-239/240	**25**	**200**	Serne and Woods, 1990	25	100-2,000	1,800	11-300,000
Ra-226	0.05	**100**	Ames and Rai, 1978				
Sr-90	25	25	Ames and Serne, 1991	25	20-200	27	0.15-3,300
Tc-99	**0.05**	**0**	Serne and Woods, 1990	0	0		
Th-228	**0.05**	**200**	Ames and Rai, 1978			60,000	2,000-510,000
Th-232	0.05	**200**	Ames and Rai, 1978			60,000	2,000-510,000
U-233/234	2	2	Serne and Woods, 1990	2	2-2,000	45	10.5-4,400
U-235	2	2	Serne and Woods, 1990	2	2-2,000	45	10.5-4,400
U-238	2	2	Serne and Woods, 1990	2	2-2,000	45	10.5-4,400
Antimony	0.05	1	Ames and Rai, 1978	0	0-40		
Arsenic	**0.05**	**3**	Baes and Sharp, 1983			3.3 (As III); 6.7 (As V)	1.0-8.3 (As III); 1.9-18 (As V)
Barium	25	25	Ames and Serne, 1991	25	20-200		
Cadmium	30	30	Ames and Serne, 1991	30	100-200	6.7	1.26-26.8
Chromium	**0.05**	**200**	Ames and Serne, 1991; Thorton et al., 1994	0 (Cr VI)	0 (Cr VI) (b)	37	1.2-1,800
Lead	30	30	Ames and Serne, 1991	30	100-200	99	4.5-7,640
Manganese	50	50	Ames and Serne, 1991	50	10-3,000	150	0.2-10,000
Mercury	30	30	Ames and Serne, 1991	30	100-200		
Zinc	30	30	Ames and Serne, 1991	30	100-200	16	0.1-8,000
Aroclor 1260 (PCB)	530	530	EPA, 1986				
Benzo(a)pyrene	5500	5500	EPA, 1986				
Chrysene	200	200	EPA, 1986				
Pentachlorophenol	53	53	EPA, 1986				

(a) Recommended conservative value for liquid waste streams with low dissolved solids concentrations (<0.01 M), low organic concentration (<2 ppm), and pH>6).

(b) Recommended conservative Kd for Cr(III) was 200, with a range from 100-500

(c) Values for most elements are geometric means of population of values in agricultural soils and clays of pH 4.5 to 9.

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Summers Model Parameters

SUMMERS MODEL PARAMETERS

Parameter Description	Type	Units	Symbol	Value
Allowable Concentration in Groundwater	Input - see Sheet 1	pCi/L or ug/L	C_gw	
Volumetric Flow to Groundwater	Calculated - do not input	ft^3/day	Q_p	57[illegible].27056
Groundwater Flow Rate	Calculated - do not input	ft^3/day	Q_gw	7200
Distribution Coefficient	Input - see Sheet 1	mL/g	K_d	
Volumetric Moisture Content	Input		m	0.09
Dry Soil Density	Input		d	1.7

Calculation of Volumetric Flow to Groundwater (A_p * q)	Site Area (A_p) - ft^2	640000
	Recharge rate (q) - ft/day	8.99E-04

Calculation of Groundwater Flow Rate (K * i * h * w)	Hydraulic conductivity (K) - ft/day	100
	Hydraulic gradient (i) - ft/ft	0.003
	Mixing zone thickness (h) - ft	30
	Mixing zone width (w) - ft	800

Contaminant Data Summary

Contaminants of Potential Concern	Groundwater Protection Standards			Distribution Coefficients
	Value	Units	Source	(mL/g)
Am-241	30	pCi/L	DCG	200
C-14	70000	pCi/L	DCG	0
Cs-134	2000	pCi/L	DCG	50
Cs-137	3000	pCi/L	DCG	50
Co-60	5000	pCi/L	DCG	50
Eu-152	20000	pCi/L	DCG	200
Eu-154	20000	pCi/L	DCG	200
Eu-155	100000	pCi/L	DCG	200
H-3	2000000	pCi/L	DCG	0
K-40	7000	pCi/L	DCG	4
Na-22	10000	pCi/L	DCG	4
Ni-63	300000	pCi/L	DCG	30
Pu-238	40	pCi/L	DCG	200
Pu-239/240	30	pCi/L	DCG	200
Ra-226	100	pCi/L	DCG	100
Sr-90	1000	pCi/L	DCG	25
Tc-99	100000	pCi/L	DCG	0
Th-228	400	pCi/L	DCG	200
Th-232	50	pCi/L	DCG	200
U-234	500	pCi/L	DCG	2
U-235	600	pCi/L	DCG	2
U-238	600	pCi/L	DCG	2
Antimony	6	ug/L	MCL	1.4
Arsenic	50	ug/L	MCL	3
Barium	1000	ug/L	MCL	25
Cadmium	5	ug/L	MCL	30
Chromium	100	ug/L	MCL	200
Lead	15	ug/L	MCL	30
Manganese	50	ug/L	MCL	50
Mercury	2	ug/L	MCL	30
Zinc	5000	ug/L	MCL	30
Aroclor 1260	0.5	ug/L	MCL	530
Benzo(a)pyrene	0.2	ug/L	MCL	5500
Chrysene	0.2	ug/L	MCL	200
Pentachlorophen	1	ug/L	MCL	53

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Contaminant

Contaminant	Leachate Concentration (C_p)	Units	Leachate Concentration (C_p)	Units	Soil Concentration (C_s)	Units
Am-241	4.05E+02	pCi/L	0.4054755	pCi/mL	81	pCi/g
C-14	9.46E+05	pCi/L	946.1095	pCi/mL	50	pCi/g
Cs-134	2.70E+04	pCi/L	27.0317	pCi/mL	1,352	pCi/g
Cs-137	4.05E+04	pCi/L	40.54755	pCi/mL	2,027	pCi/g
Co-60	6.76E+04	pCi/L	67.57925	pCi/mL	3,379	pCi/g
Eu-152	2.70E+05	pCi/L	270.317	pCi/mL	54,063	pCi/g
Eu-154	2.70E+05	pCi/L	270.317	pCi/mL	54,063	pCi/g
Eu-155	1.35E+06	pCi/L	1351.585	pCi/mL	270,317	pCi/g
H-3	2.70E+07	pCi/L	27031.7	pCi/mL	1,431	pCi/g
K-40	9.46E+04	pCi/L	94.61095	pCi/mL	378	pCi/g
Na-22	1.35E+05	pCi/L	135.1585	pCi/mL	541	pCi/g
Ni-63	4.05E+06	pCi/L	4054.755	pCi/mL	121,643	pCi/g
Pu-238	5.41E+02	pCi/L	0.540634	pCi/mL	108	pCi/g
Pu-239/240	4.05E+02	pCi/L	0.4054755	pCi/mL	81	pCi/g
Ra-226	1.35E+03	pCi/L	1.351585	pCi/mL	135	pCi/g
Sr-90	1.35E+04	pCi/L	13.51585	pCi/mL	338	pCi/g
Tc-99	1.35E+06	pCi/L	1351.585	pCi/mL	72	pCi/g
Th-228	5.41E+03	pCi/L	5.40634	pCi/mL	1,081	pCi/g
Th-232	6.76E+02	pCi/L	0.6757925	pCi/mL	135	pCi/g
U-234	6.76E+03	pCi/L	6.757925	pCi/mL	14	pCi/g
U-235	8.11E+03	pCi/L	8.10951	pCi/mL	16	pCi/g
U-238	8.11E+03	pCi/L	8.10951	pCi/mL	16	pCi/g
Antimony	8.11E+01	ug/L	0.0810951	ug/mL	0.11	ug/g
Arsenic	6.76E+02	ug/L	0.6757925	ug/mL	2	ug/g
Barium	1.35E+04	ug/L	13.51585	ug/mL	338	ug/g
Cadmium	6.76E+01	ug/L	0.06757925	ug/mL	2	ug/g
Chromium	1.35E+03	ug/L	1.351585	ug/mL	270	ug/g
Lead	2.03E+02	ug/L	0.20273775	ug/mL	6	ug/g
Manganese	6.76E+02	ug/L	0.6757925	ug/mL	34	ug/g
Mercury	2.70E+01	ug/L	0.0270317	ug/mL	1	ug/g
Zinc	6.76E+04	ug/L	67.57925	ug/mL	2,027	ug/g
Aroclor 1260	6.76E+00	ug/L	0.006757925	ug/mL	4	ug/g
Benzo(a)pyrene	2.70E+00	ug/L	0.00270317	ug/mL	15	ug/g
Chrysene	2.70E+00	ug/L	0.00270317	ug/mL	1	ug/g
Pentachlorophenol	1.35E+01	ug/L	0.01351585	ug/mL	1	ug/g

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APPENDIX E

100-HR-1 OPERABLE UNIT
FOCUSED FEASIBILITY STUDY REPORT

ACRONYMS

ARAR	applicable or relevant and appropriate requirements
ARCL	allowable residual contamination levels
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	*Code of Federal Regulations*
COPC	contaminants of potential concern
EPA	U.S. Environmental Protection Agency
FFS	focused feasibility study
NEPA	*National Environmental Policy Act*
RCRA	*Resource Conservation and Recovery Act of 1976*

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CONTENTS

CONTENTS (continued)

FIGURES

TABLES

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CONTENTS (continued)

TABLES (continued)

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1.0 INTRODUCTION

The objective of this operable unit-specific focused feasibility study (FFS) is to provide decision makers with sufficient information to allow appropriate and timely selection of interim remedial measures for sites associated with the 100-HR-1 Operable Unit. As discussed in the main text, certain inherent assumptions are required to establish "appropriate and timely" interim remedial measures. The assumptions and qualifiers outlined in the main text have been followed in the work being performed in this appendix. The plug-in approach is used in this appendix and is based on the same land use and groundwater use scenario as used in the Process Document. The Sensitivity Analysis is then used as a basis to discuss changes to the detailed investigation because of other land use and/or groundwater use scenarios.

The Process Document and this operable unit-specific FFS are based on an exposure scenario that includes occasional use of the land and frequent use of the groundwater. The Sensitivity Analysis (Appendix D) has been developed to show the impacts of additional exposure scenarios. The interim remedial measure candidate waste sites are determined in the limited field investigation (DOE-RL 1993b). Site profiles are developed for each of these waste sites. The site profiles are used in the application of the plug-in approach. The waste site either plugs into the analysis of the alternatives for the group, or deviations from the developed group alternatives are described and documented. A summary of the FFS results for the 100-HR-1 interim remedial measure candidate waste sites is as follows:

- None of the waste sites require additional alternative development.
- Three of the waste sites directly plug into the waste site group alternative (132-H-1, 132-H-2, and 132-H-3). The site-specific detailed analysis is conducted referencing the waste site group analysis as appropriate. A waste site detailed analysis summary is presented in Table E5-1.
- A comparative analysis of Remedial Alternatives is presented for each waste site.

1.1 PURPOSE AND SCOPE

The scope of this document is limited to 100-HR-1 Operable Unit interim remedial measure candidate sites as determined in the limited field investigation. Impacted groundwater beneath the 100-H Area shall be addressed in the 100-HR-3 FFS report. In addition, low priority waste sites and potentially impacted river sediments near the 100 Area are not considered candidates for interim remedial measures; they are being addressed under the remedial field investigation/corrective measures study pathway of the *Hanford Past Practice Strategy* (DOE-RL 1991). The decision to limit the scope of the FFS is documented and justified in the work plan, limited field investigation, qualitative risk assessment, and the 100 Area feasibility study Phase I and II (DOE-RL 1993a).

This report presents the following:

- The 100-HR-1 Operable Unit individual waste site information (Section 2.0)
- The development of individual site profiles (Section 2.0)
- The identification of representative groups for individual waste sites and a comparison against the applicability criteria and identification of appropriate enhancements for the alternatives (Section 3.0)
- A discussion of the deviations and/or enhancements of an alternative and additional alternative development, as needed (Section 4.0).
- The detailed analyses for waste sites which deviate from the representative group alternatives (Section 5.0).
- The comparative analysis for all individual waste sites using the Process Document baseline scenario (Section 6.0)
- A discussion of the modifications to the baseline scenario due to the results of the Sensitivity Analysis (Section 7.0)
- A comparative analysis for all individual waste sites using the revised scenario as developed in the Sensitivity Analysis (Section 7.0), if applicable.

1.2 INCORPORATION OF NATIONAL ENVIRONMENTAL POLICY ACT VALUES

In accordance with DOE Order 5400.4 and Chapter 10 of the *Code of Federal Regulations* (CFR) Part 1021, the considerations (values) of the *National Environmental Policy Act of 1969* (NEPA) must be incorporated in the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) process. The NEPA values are incorporated in the Process Document (Section 3.3).

The NEPA values, such as description of the affected environment (including meteorology, hydrology, geology, ecological resources, and land use), applicable laws and guidelines, short-term and long-term impacts on human health and the environment, and cost are included to a limited degree within a typical CERCLA feasibility study. Other NEPA values not normally addressed in CERCLA feasibility study, such as socio-economic impacts, cultural resources, and transportation impacts, have been evaluated in the Process Document.

The NEPA impacts that are specific to the 100-HR-1 Operable Unit and a detailed analysis of alternatives are addressed in Section 5.0 of this document.

2.0 WASTE SITE INFORMATION

2.1 OPERABLE UNIT BACKGROUND

The 100 Area at the Hanford Site is located in Benton County along the southern banks of the Columbia River, in the north central part of the site (Figure E2-1). The 100-HR-1 Operable Unit comprises the northeast portion of the 100-H Area and is located immediately adjacent to the Columbia River shoreline. The 100-HR-1 Operable Unit encompasses approximately 0.4 km^2 (0.16 mi^2) of the 100-H Area. It lies primarily within the northeast quadrant of Section 18, Township 14N, Range 27E.

The 100-HR-1 Operable Unit is one of three operable units associated with the 100-H Area at the Hanford Site. The 100-HR-1 and 100-HR-2 are source operable units that address liquid effluent disposal sites, solid waste burial grounds, and their underlying vadose zone. The 100-HR-1 Operable Unit contains waste units associated with the disposal of liquid wastes and cooling water during operation of the H Reactor. The 100-HR-1 Operable Unit contains most of the sites in the 100-H Area that were involved in plutonium production, including the 100-H Reactor and its cooling system. The 100-HR-2 Operable Unit contains primarily solid waste burial grounds. The 100-HR-3 Groundwater Operable Unit addresses contamination that has migrated to the groundwater from both of the 100-H Area source operable units, and from the source operable units in the 100-D/DR Area approximately 3.5 km (2 mi) southwest of the 100-H Area.

The 100-H Reactor was the sixth Hanford reactor built to manufacture plutonium during World War II. Fuel elements for the reactor were assembled in the 300 Area, and the plutonium-enriched fuel produced by the reactor was processed in the 200 Area. The 100-H Reactor operated from 1945 to 1965, when it was retired. After the reactor was retired, decontamination and decommissioning activities were initiated to minimize the potential spread of radioactive and other potential contaminants. This process is ongoing, although most of the structures in the 100-H Area have been demolished.

Since the preparation of the *100 Area Feasibility Study Phases 1 and 2* (DOE-RL 1993a), additional data relevant to this FFS have been collected in both the 100 Area in general, and in the 100-HR-1 Operable Unit specifically. An LFI and QRA were performed for the 100-HR-1 Operable Unit (DOE-RL 1993b, WHC 1993). In addition, aggregate area studies were conducted to evaluate cultural and ecological resources within the 100 Area.

2.2 100 AREA AGGREGATE STUDIES

Hanford Site studies and studies within the 100 Area, such as the Hanford Site Background studies, provide integrated analyses of selected issues on a scale larger than the operable unit. The 100 Area groundwater operable unit work plans (e.g., DOE-RL 1992a, 1992c, and 1992d [the work plans for HR-3, FR-3, and KR-4]) provide information common to the 100 Area, covering topics such as river impacts, shoreline ecology, and cultural resources. The 100-H Area source and groundwater operable unit work plans provide detail on the physical setting within the 100-H Area, such as land form, geology, groundwater, surface water, meteorology, natural resources, and human resources (e.g., DOE-RL 1992a and 1992b). Studies that are applicable to this 100 Area source operable unit FFS are summarized in the following subsections.

2.2.1 Hanford Site Background Study

The characterization of the natural chemical composition of Hanford Site soils is presented in *Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes* (DOE-RL 1993c). The background values for inorganic constituents in soils, based on the above report, are discussed in Section 2.0 and Appendix A of the Process Document. Background values for radionuclides are currently under evaluation, but only a few are available at this time (see Appendix A of the Process Document).

2.2.2 Ecological Studies

Bird, mammal, and plant surveys in the 100 Area were conducted and reported by Sackschewsky and Landeen (1992). Conceptual food pathways and inventories of wildlife and plants at the Hanford Site, including threatened and endangered species, were presented by Weiss and Mitchell (1992). Cadwell (1994), described the aquatic species in the Hanford Reach of the Columbia River, the spatial distribution of vegetation types at Hanford, and surveys of species of concern, such as the shrub-steppe vegetation, threatened and endangered birds, and mule deer and elk populations. Cadwell (1994) concluded that intrusive-type remedial activities conducted inside the controlled-area fences should not have a significant impact on the wildlife. Landeen et al. (1993) stated that intrusive activities outside the controlled-area fences should have minimal impact on protected wildlife species if the recommendations contained in the three documents listed below are followed.

- *Bald Eagle Site Management Plan for the Hanford Site, South Central Washington* (Fitzner and Weiss 1994)
- *Biological Assessment for Threatened and Endangered Wildlife Species* (Fitzner, Weiss, and Stegan 1994)
- *Biological Assessment for State Candidate and Monitor Species* (Stegen 1992).

The plant communities near the 100-H Area have been broadly described as a riparian community immediately adjacent to the Columbia River and a cheatgrass community away from the river. The shoreline immediately adjacent to the 100-H Area is steeply sloped with a narrow riparian zone, dominated by reed canarygrass and bluegrass with white mulberry and golden currant. Much of the river shoreline consists of large cobbles and boulders. Near the south boundary of the 100-H Area, the shoreline abruptly flattens into an extensive backwater wetland known as the H-slough that supports a wide variety of plants and animals. To the north, upriver of the 100-H Area, is another small wetland area. The White Bluffs ferry site, south of the 100-H Area, is dominated by stands of mature cottonwood and black locust trees.

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The area within the 100-H Area boundary but away from the river, is primarily a cheatgrass/rabbitbrush community (Stegen 1994). Many areas within the 100-H Area have been physically disturbed by the original construction and operation of the reactor, and more recently by remedial work on the buildings and waste sites. The vegetation in the vicinity of, but outside the 100-H Area, consists primarily of cheatgrass communities, abandoned agricultural fields, or smaller areas of sagebrush/bitterbrush.

The habitats along the Columbia River support a wide variety of mammals, birds, reptiles, and insects. Habitats or vegetation that should be protected from damage during remedial work at the 100-H Area include the small areas of sagebrush/bitterbrush, the trees in the area, and riparian and wetland communities along the river.

The birds, mammals, reptiles, insects, and sensitive species found in the 100-H Area are the same as those common to the Hanford Site, and are discussed in Section 3.3 of the Process Document. The aquatic ecology of the 100 Area is also described in Section 3.3 of the Process Document. Large islands in the Columbia River immediately northeast (Locke Island) and north of the 100-H Area provide resting, nesting, and escape habitat for waterfowl, shorebirds, small mammals, and mule deer. Major fall Chinook Salmon spawning areas occur between the 100-H Area shorelines and Locke Island.

Bald eagles, a federal and state listed threatened species, are seasonal residents at the Hanford Site, primarily along the river during November through March. There are several frequently used perch trees at the north end of the 100-H Area and several frequently used ground perches north and south of the 100-H Area. Bald eagles also use perch trees and ground perches on Locke Island while resting or feeding. Remedial activities at the 100-H Area will have to be scheduled and conducted to avoid disturbing the eagles feeding and roosting activities. Guidance on issues dealing with bald eagles can be found in the Bald Eagle Site Management Plan (Fitzner and Weiss 1994). Peregrine falcons, a federally listed endangered species, have been observed only infrequently at the Hanford Site. They may use the area as a resting or feeding area during spring and fall migrations, but they do not nest at the Hanford Site.

Other species of concern that could potentially be influenced by remedial work in the 100-H Area include the Swainson's hawk, the ferruginous hawk, sepal yellowcress, and two aquatic molluscs (the Columbia pebblesnail and shortfaced lanx). The molluscs could be impacted if erosion causes an increase in sediment loads in the river or degraded water quality. Swainson's hawks, a state and federal candidate species, nest in many of the trees planted around the White Bluffs Townsite (south of the 100-H Area) in the 1940's. These hawks will return to the same nesting sites year after year. Nesting ferruginous hawks are becoming more common at the Hanford Site (Fitzner and Newell 1989), but most nest south, or across the river from the 100-H Area. Canadian geese and other waterfowl and shore birds nest in the wetland sloughs and river islands above and below the 100-H Area. Common mammals in the area include mule deer, coyote, Great Basin pocket mouse, jackrabbits, cottontail rabbits, and skunks.

2.2.3 Cultural Resources

Various cultural resource-related investigations have been conducted in the 100-H Area over the last few decades. The investigations include archaeological reconnaissances, systematic surveys, test excavations, and interviews with Native Americans with historical ties to the area (Chatters, Gard, and Minthorn 1992; Relander 1986; Rice 1968 and 1980; Wright 1993). These investigations have resulted in the identification of several archaeological and ethnohistoric sites in and around the 100-HR-1 Operable Unit, which could range in age from 9,000 years ago to the mid-nineteenth century.

The historic Wanapum Indian village of Tacht (45BN176), located 1 km (0.6 m) south of the 100-H reactor facility, was occupied into the early 1940s, when the Wanapum agreed to move so that the U.S. Government could pursue its agenda (Cushing 1994). The northern portion of the 100-HR-1 Operable Unit along the river has not been surface surveyed. It is likely that archaeological sites are located in this area because areas located within 400 m (1,300 ft) of the Columbia River are considered as having high potential for cultural resources (Chatters 1989). Areas to the west, south, and east of the heavily disturbed central portions of the reactor complex were surface surveyed in the 1990s for evidence of archaeological sites and none were found. It is possible, however, that subsurface archaeological deposits might exist within those areas, especially those portions within the 400 m (1,300 ft) zone discussed above. In addition, because discussions with Native American peoples with historical ties to 100-H Area have yet to take place, other areas might be considered sacred or to be traditional cultural properties. Such discussions are planned for 1995.

Cultural resource impact assessments are being conducted for each waste site in the 100-H Area. Assessment scores will be determined and presented in an action plan being prepared for 100-H Reactor Area by ERC cultural resource staff. These assessments will accelerate cultural resource reviews and clearances, which are required of all Hanford Site projects involving ground disturbing activities, as mandated in the Hanford Cultural Resource Management Plan (Chatters 1989).

The following waste sites discussed in this document have high cultural resource sensitivity, so any work done involving these sites should include cultural resource staff to incorporate cultural resource concerns into remedial action decision making:

- 116-H-1 Process Effluent Disposal Trench
- 116-H-7 Sludge Burial Trench
- Process Effluent Pipelines.

Based on this existing information, the 100-HR-1 Operable Unit is considered to be extremely sensitive for cultural resources. Sensitive areas include not only those areas where cultural resources have been identified from previous surface investigations (the locations of which cannot be released in public documents), but also those areas where there is high potential for, but no surface indications of, subsurface cultural resources. Future remedial activities at high-priority waste sites in the Operable Unit (such as 116-H-1 and 116-H-7)

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are of particular concern. While it appears that these areas were disturbed during construction of the reactor and related structures during the 1940's, the horizontal and vertical extent of this disturbance is not known Therefore it is possible that intact archaeological deposits exist in the area. Because of Tribal concerns, clean-up activities must incorporate actions to protect cultural resources.

2.2.4 Summary

The potential influence of remedial actions on the resources described in the preceding subsection s are considered during the analysis of Remedial Alternatives conducted in Sections 5.0 and 6.0 of the Process Document and Sections 5.0, 6.0, and 7.0 of this 100-HR-1 FFS. Other issues, such as potential transportation and socioeconomic impacts are also discussed in Sections 3.3 and 5.2 of the Process Document. The assessment of potential impacts in the Process Document are consistent with the potential impacts anticipated as a result of remediating the individual waste sites at the 100-HR-1 Operable Unit. Mitigation measures, as discussed in Section 5.2.2 of the Process Document, will be developed during the conceptual and preliminary design of the selected Remedial Alternative to avoid or minimize impacts on physical, biological, and cultural resources.

2.3 LIMITED FIELD INVESTIGATION

The LFI is an integral part of the RI/FS process and is based on Hanford-specific agreements discussed in the *Hanford Federal Facility Agreement and Consent Order* (Fourth Amendment) (Ecology et al. 1994), the *Hanford Site Risk Assessment Methodology* (DOE-RL 1995), the *RCRA Facility Investigation/Corrective Measures Study Work Plan for the 100-HR-1 Operable Unit* (DOE-RL 1992b), and the *Hanford Past-Practice Strategy (HPPS)* (DOE-RL 1991). The HPPS emphasizes initiating and completing waste site cleanup through interim actions.

The primary purpose of the LFI at the 100-HR-1 Operable Unit (DOE-RL 1993b) was to collect sufficient data to recommend which sites should remain as candidates for interim remedial measures (IRM). Sites that are not recommended for an IRM will be addressed later during the final remedy selection process for the entire 100 Area. The data gathered in the LFI are also used to evaluate Remedial Alternatives in this FFS.

A Qualitative Risk Assessment (QRA) was performed as part of the LFI, and determined the principal risk drivers at the 100-HR-1 Operable Unit. Another purpose of the 100-HR-1 QRA (WHC 1993) was to qualitatively evaluate human health and environmental exposure scenarios to help determine which waste sites within the 100-HR-1 Operable Unit were candidates for IRM. The QRA evaluated risks for a predefined set of human and environmental exposure scenarios, and is not intended to replace or be a substitute for a baseline risk assessment.

The QRA considered only two human health exposure scenarios (frequent- and occasional-use) with four pathways (soil ingestion, fugitive dust inhalation, inhalation of volatile organics from soil, and external radiation exposure), and an ecological exposure scenario based on ingestion of plants by the Great Basin pocket mouse.

For the human health risk assessment,frequent- and occasional-use exposure scenarios were evaluated to provide bounding estimates of risk consistent with the residential and recreational exposure scenarios presented in the *Hanford Site Risk Assessment Methodology* (DOE-RL 1995). Currently there are no such land uses in the 100-HR-1 Operable Unit. The estimated risks associated with carcinogenic contaminants at 100-HR-1 were grouped into four categories based on lifetime incremental cancer risk (ICR):

- high - ICR $>1 \times 10^{-2}$
- medium - ICR between 1×10^{-4} and 1×10^{-2}
- low - ICR between 1×10^{-6} and 1×10^{-4}
- very low - ICR $<1 \times 10^{-6}$.

A frequent-use scenario was evaluated in the year 2018 to ascertain potential future risks associated with each waste site after additional radionuclide decay. For the current occasional-use scenario, the effect of radiation shielding by the upper 2 m (6 ft) of soil on the external exposure risk at each waste site was also evaluated.

The ecological risk assessment evaluated contaminant uptake by the Great Basin pocket mouse. The mouse was used as an indicator receptor because it is common at the Hanford Site, its home range is comparable to the size of most waste sites, and it lives in close proximity to the contaminants in the soil. Ecological risks were defined by estimating the amount of contaminants received through ingestion of food, and then calculating an environmental hazard quotient. An environmental hazard quotient greater than one (unity) indicates that the contaminant poses a risk to individual mice.

The results of the LFI/QRA were used to select the sites where IRM should be evaluated. If an IRM is not justified, the site will be subject to further investigation and/or remediation under the site-wide RI/FS process. The LFI report for the 100-HR-1 Operable Unit described the field sampling program, identified the constituent concentrations at each of the sites, presented the data analysis, and discussed the risk assessment conclusions for the operable unit (DOE-RL 1993b).

Based on the LFI/QRA, waste sites at the 100-HR-1 Operable Unit were retained as IRM candidates if:

- The site posed a medium or high incremental cancer risk to humans under the occasional-use scenario

- The site contained noncarcinogenic contaminants that exceeded a human health hazard quotient of 1.0

- The site contained contaminants that posed a risk to the Great Basin pocket mouse (Environmental Hazard Quotient [EHQ] greater than 1.0)

- The conceptual exposure model could not be completed because of insufficient data
- The site had contaminants at levels that exceeded applicable or relevant and appropriate requirements (ARAR) in Appendix C of the Process Document
- The site had a probable current impact on groundwater, based on comparing onsite contaminant concentrations to groundwater protection criteria.

The LFI also assumed that solid waste burial grounds are IRM candidate sites regardless of the above criteria. The IRM candidacy review conducted during the LFI evaluation retained eight waste sites as IRM candidates (Table E2-1).

Although the outfall structures at the 100-HR-1 Operable Unit were determined to be IRM candidate sites in the LFI, they have been recently designated for an expedited response action, in conjunction with the effluent pipelines at the operable unit. The *100 Area River Effluent Pipelines Expedited Response Action Proposal* (DOE-RL 1994) states that the 100 Area outfall structures will be addressed concurrently with the river pipelines. The 116-H-5 outfall structure is therefore, not addressed further in this FFS.

The conclusions drawn from the LFI and QRA studies were used solely to determine IRM candidacy for high-priority waste sites and solid waste burial grounds within the 100-HR-1 Operable Unit. While this FFS report relies on the data presented in the LFI/QRA, the conclusions drawn in this FFS are based on the analyses of the Remedial Alternatives in Sections 5.0 and 6.0 of the Process Document, Sections 4.0 and 5.0 in the Sensitivity Analysis (Appendix D), and this FFS (Appendix E).

2.4 DEVELOPMENT OF WASTE SITE PROFILES

To facilitate the implementation of the plug-in approach described in Section 1.0, waste-site profiles have been developed for each of the seven IRM candidate sites within the 100-HR-1 Operable Unit. These seven IRM candidate sites were selected from a total of 13 high-priority waste sites (Table E2-1) within the 100-HR-1 Operable Unit during the LFI study (DOE-RL 1993b). The individual site profiles were developed using radiological data from Dorian and Richards (1978), field data obtained during the 1992 LFI, and information acquired during decontamination and decommissioning activities. When site-specific data were unavailable, data from an analogous site were assumed to be the most appropriate information for describing the conditions at the 100-HR-1 IRM site, and developing its waste-site profile.

2.4.1 Site Descriptions

The first step in developing the individual waste-site profiles was to prepare a basic site description of each IRM candidate site (Table E2-2). This included listing the name of the site, describing its use during the operation of the H Reactor, describing its physical characteristics (the size and structural material), and determining which one of the waste-site groups the individual waste site belonged in. The waste-site groups are listed in Section 5.0 of this FFS and are described in Section 3.0 of the Process Document.

2.4.2 Refined Contaminants of Potential Concern

To develop the individual waste-site profiles, another activity was determining what contaminants were present at each waste site that posed a risk to humans, biological receptors (plants and animals), and groundwater quality. These so-called "refined COPC" are the risk drivers at the site and represent the contaminants that have to be remediated. The refined COPC were identified by starting with the list of COPC developed during the LFI and screening these contaminants against more stringent risk criteria.

The COPC (from the LFI) are defined as those contaminants that are known to occur within the operable unit or waste site, and were present at concentrations that exceeded natural background levels or conservative human risk criteria (ICR > 10^{-7} or HQ > 1.0). For example, if strontium-90 was present at soil concentrations above 193 pCi/g, it presented an incremental cancer risk greater than 10^{-7} and was considered a COPC. If strontium-90 concentrations were below this level the concentrations were considered to be below levels requiring further evaluation, and the contaminant was not a COPC.

The refined COPC for each of the IRM candidate sites at the 100-HR-1 Operable Unit were identified by comparing the concentrations of the COPC to the preliminary remediation goals (PRG) developed in Section 2.0 and Appendix A of the Process Document. If the maximum COPC concentration at the waste site exceeded any of the PRGs, then that contaminant was considered a refined COPC. There can be one to several refined-COPC at each site, and the number and types of refined-COPC are used to help determine which Remedial Alternatives may be appropriate at the site. The derivation of the PRGs is described in Appendix A of the Process Document. The PRG represents the maximum concentration of a contaminant that would not exceed an acceptable human health or ecological risk level, or would not exceed the groundwater protection criteria. Table E2-3 presents the PRGs that were developed in the Process Document. These preliminary remediation goals were never set at concentrations that were below natural background concentrations, to preclude trying to remediate naturally existing constituents in soils. Also, if the risk based PRG was less that the laboratory required quantification/detection limit for that particular contaminant, then the quantification/detection limit was used as the PRG (for example, the PRG for carbon-14 was set at 50 pCi/g even though the groundwater protection PRG is 18 pCi/g, Table E2-3).

Two or more PRGs were determined for each COPC identified in the LFI, as shown in Table E2-3. All COPC had a PRG that represented a concentration protective of groundwater, and almost all COPC had a PRG based on human health risks assuming a recreational exposure scenario. The PRGs for the carcinogenic radionuclides and chemicals represented the soil concentration that would pose an incremental cancer risk of one in a million. The human health PRGs for noncarcinogenic chemicals represented the concentration that would result in a hazard quotient of 0.1. For a given contaminant, the most stringent PRG was used, and the PRG were applied at two different depth strata depending on whether human and biological receptors would be exposed or protection of groundwater is the main factor. For example, for cobalt-60 the most stringent PRG is the one in a million incremental cancer risk level (soil concentration of 17.5 pCi/g). This PRG (17.5) is applicable at the 0 to 3-m (0 to 10-ft) depth strata because (1) humans are exposed to contaminants within the 0 to 1 m (0 to 3 ft) strata (assuming a recreational exposure scenario) and (2) the human health-based PRG is used at depth strata where animals and plants 0 to 3 m (0 to 10 ft) are exposed because there is no ecological-based PRG available for cobalt-60 (i.e., the human health PRG is used as default values). It was assumed that there were no exposure pathways that would link contaminants below 3 m (10 ft) to humans, animals, or plants; therefore, the groundwater protection PRG (1292 pCi/g) is applied at the > 3-m (10-ft) depth strata. The groundwater protection PRG is also applied to the 0 to 3-m (0 to 10-ft) depth strata if it is more stringent than the human risk PRGs.

To identify the refined COPC at each waste site, several assumptions and protocols were used to compare the COPC to the PRGs. These include the following:

- The soils within the waste site were divided into two depth strata, corresponding to the depth strata that the human and biological receptors and groundwater could be exposed to. This approach is discussed in detail in Section 2.0 and Appendix A of the Process Document.

- At each waste site, the maximum concentration of each contaminant (COPC) within each stratum was identified. The maximum concentration was taken from either the LFI data set or the Dorian and Richards (1978) data set.

- The historical data set (Dorian and Richards 1978) was modified to account for radioactive decay between 1978 and 1992, so it was consistent with the LFI data set collected in 1992.

- If a sample was collected at the boundary between two strata (i.e., at 1 m [3 ft]) the data from that sample were applied to the shallower stratum (i.e., the 0 to 1 m [0 to 3 ft] strata).

- Historical or LFI data reported within a range (e.g., 2.6 to 4.8 m [8.5 to 16 ft]) were applied to two depth strata if appropriate (e.g., the 0 to 3 m [0 to 10 ft] and the greater than 3 m [10 ft] ranges).

- The nickel-63 concentrations reported by Dorian and Richards (1978) may have been analyzed using a surrogate. Therefore, the concentrations reported in this FFS may not be an accurate representation of the actual concentration at the waste site. For the purpose of this FFS, the nickel-63 concentrations reported by Dorian and Richards were used as the best available estimate.

- Total uranium concentrations were reported by Dorian and Richards (1978) rather than specific isotopes. For the purpose of this FFS, the total concentrations were considered to be uranium-238 because uranium-238 was determined to be the major risk contributor of the uranium isotopes during the QRA.

The screening process that compares the COPC to PRG and identifies the refined COPC results in the identification of the contaminants that must be addressed by remedial action at the given IRM candidate site. Tables E2-4 and E2-5 present the PRG screening for the two IRM candidate sites at the 100-HR-1 Operable Unit that have analytical data.

2.4.3 Waste-site Profiles

The waste-site profiles characterizing each individual waste site are presented in Table E2-6. Each profile includes the extent of contamination (how much soil may have to be excavated or what area may have to be capped), the depth of contamination, the media (i.e., soil) or material at the waste site, a list of refined COPCs at the waste site, and the maximum concentration observed for each refined-COPC. The waste-site profiles also state if the contaminant concentrations exceed the reduced infiltration concentration. The reduced infiltration concentration is the soil concentration that is considered protective of groundwater under the assumption that hydraulic infiltration is limited by a surface barrier over the wastes. The reduced infiltration concentrations are presented in Table E2-7; their derivation is discussed in Appendix A of the Process Document.

The waste-site profiles serve several purposes. First, they contain information needed to compare each waste site at 100-HR-1 to the Waste Site Groups developed in Section 3.0 of the Process Document. The profile information is also used to compare the site characteristics of each waste site with the applicability criteria developed in Section 4.0 of the Process Document, to help determine which Remedial Alternatives are or are not appropriate for that site. The area, depth, and volume of contamination is used to determine how much soil may have to be excavated, treated, capped, etc.; this has a direct bearing on time and costs for remedial action. The information in the profiles is explained more in the following paragraphs, and the actual profiles are presented in Table E2-6.

- <u>Extent of Contamination</u> - This includes the volume, length, width, area, and thickness of the contaminated media. The volume estimates performed for each site are presented in Attachment 1 of this document. Volume, length, width, and area do not necessarily impact the determination of appropriate Remedial Alternatives, however they are important considerations for developing costs and estimating the time required for remedial actions. Thickness of the contaminated lens impacts the implementability of In Situ actions such as vitrification, which has a limited vertical extent of influence.

- <u>Contaminated Media/Material</u> - Contaminated media and material located at the site are determined and described. Structural materials such as steel, concrete, and wooden timbers influence the applicability of Remedial Alternatives, as well as equipment needed for actions such as removal. The presence of solid wastes will influence material handling considerations and may require Remedial Alternatives which are different than alternatives for sites with just contaminated soil.

- <u>Refined COPC/Maximum Concentrations</u> - Refined COPC for a site are determined as discussed in Section 2.4.2. The associated maximum concentration for each refined COPC is the highest concentration detected at the site. Refined COPC may

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influence the applicability of Remedial Alternatives. For example, the presence of certain radioactive contaminants may allow natural decay to be considered in determining appropriate remedial actions. The presence of organic contaminants may require that enhancements, such as thermal desorption, be added to a treatment system.

- Reduced Infiltration Concentration - The reduced infiltration concentration is a level which is considered protective of groundwater under a scenario where hydraulic infiltration is limited by the application of a surface barrier. The maximum refined COPC concentration detected is compared to the allowable reduced infiltration concentration. Exceedance of the reduced infiltration concentrations indicates that containment alternatives using a surface cap may not prevent contaminants from leaching into the groundwater below the site.

The following Section 3.0 on application of the plug-in approach describes the use of the site profiles during the feasibility study process.

Figure E2-1. 100-HR-1 Operable Unit Map.

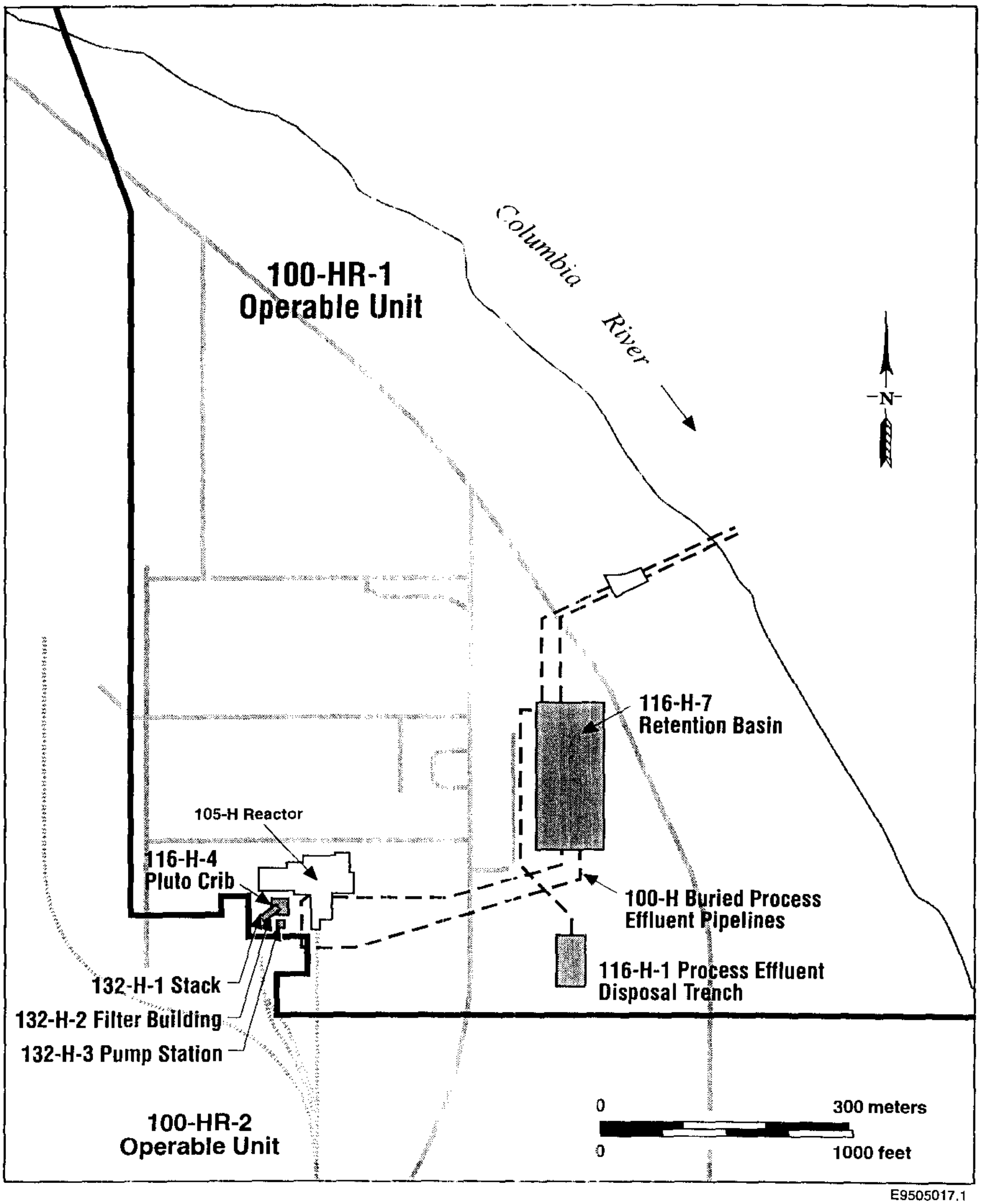

Table E2-1. Interim Remedial Measures Recommendations from the 100-HR-1 Limited Field Investigation.

Waste Site	Qualitative Risk Assessment		Conceptual Model	Exceeds ARAR	Probable Current Impact on Groundwater	Potential for Natural Attenuation by 2018	IRM Candidate yes/no
	Low-frequency use scenario	EHQ >1					
116-H-1 Process Effluent Disposal Trench	Medium	Yes	Adequate	Yes	Yes	No	Yes
116-H-2 Effluent Disposal Trench	Low	Yes	Incomplete(a)	No	No	No	Yes(b)
116-H-3 Dummy Decontamination French Drain	Low	No	Adequate	No	No	Yes	No
116-H-7 Process Effluent Retention Basin	High	Yes	Adequate	Yes	Yes	No	Yes
116-H-9 Confinement Seal Pit Drainage Crib	Low	No	Adequate	No	No	Yes	No
116-H-5 Process Effluent Outfall Structure	Medium	--	Adequate	No	No	No	Yes
Process Effluent Pipelines (Soil)	Very Low	No	Adequate	No	Yes	No	Yes
Process Effluent Pipelines (Sludge)	High	No	Adequate	No	Yes	No	Yes
116-H-7 Sludge Burial Trench	Very Low	--	Adequate	No	No	No	No
132-H-3 Effluent Pumping Station	Low	--	Adequate	Unknown	Unknown	Unknown	Yes
132-H-2 Exhaust Air Filter Building	Low	-	Adequate	Unknown	No	Unknown	Yes
132-H-1 Reactor Exhaust Stack	Low	--	Adequate	Unknown	No	Unknown	Yes
116-H-4 Pluto Crib	Low	--	Adequate	Unknown	No	Unknown	Yes

EHQ = Environmental Hazard Quotient (calculated by the qualitative ecological risk assessment [WHC 1993]).
-- = not rated by the qualitative ecological risk assessment.
(a) = conceptual model is considered incomplete because of discrepancies between the limited field investigation (LFI) data and historical data. The LFI data indicates little or no contamination that contradicts with the historical data. Additional investigation may be necessary.
(b) = data needed concerning nature and vertical extent of contamination, site remains an interim remedial measure (IRM) candidate until data are available. However, this site was not included in the analysis of remedial alternatives in this FFS report.
ARAR = applicable or relevant and appropriated requirements, specifically the *Washington State Model Toxics Control Act* Method B concentration values for soils (DOE-RL 1992b).

Table E2-2. 100-HR-1 Interim Remedial Measure Waste Site Description.

Site Number/ Name (Alias)	Previous Use	Physical Description	Data Source
116-H-7/ (107-H Retention Basin)	Held cooling water effluent from H Reactor for short-term cooling/decay before release to Columbia River.	Retention Basin Reinforced concrete, single containment. 192.6 x 84.1 x 6.1 m (631.9 x 275.9 x 20 ft) deep	LFI, historical
116-H-1/ Process Effluent Disposal Trench (107-H Liquid Waste Disposal Trench)	Received high activity effluent produced by ruptured fuel elements. Received sludge from 116-H-7 retention basin when 100-H Area was deactivated. Also received 90 kg of sodium dichromate.	Trench Unlined 58.8 x 33.5 x 4.6 m (192.9 x 105.9 x 15.09 ft) deep	LFI, historical
116-H-4/ Pluto Crib (105-H Pluto Crib)	Received cooling water discharge contaminated by failed fuel elements. Received 1,000 kg of sodium dichromate. Crib was excavated and material buried in 118-H-5 burial ground 132-H-2 exhaust air filter building was later built on the same site.	Crib/French Drain Unlined pluto crib. 3.1 x 3.1 x 3.1 m (10.17 x 10.17 x 10. 17 ft) deep	No analytical data
Buried Pipelines	Transported reactor cooling water from reactors to retention basins, outfall structures, and 116-H-1 trench; leaked effluent to soil, contains contaminated sludge and scale.	Process Effluent Pipelines Total length ≈1228 m (4,028 ft); pipe diameter varies; depth below surface varies.	Historical
132-H-1/(116-H Reactor Exhaust Stack)	Contaminated stack demolished in place, buried, and covered with 1.5 m (4.9 ft) fill.	D&D Facility Demolished reinforced concrete exhaust stack. 67.1 x 7.6 x 4.6 m (220.14 x 24.93 x 25.09 ft) deep	D&D (Beckstrom 1987)
132-H-2/(117-H Exhaust Air Filter Building)	Contaminated building demolished in place, buried, and covered with 5 m (16.4 ft) fill. Building was built on site of the demolished and removed 116-H-4 pluto crib.	D&D Facility Demolished reinforced concrete building 22.6 x 12.5 x 12.5 x 8.8 m (74.15 x 41 x 41 x 28.87 ft) deep	D&D (Beckstrom 1984)
132-H-3/(1608-H Effluent Pumping Station)	Collected and pumped water from H Reactor drains, including irradiated fuel storage drains, into 116-H-7 process effluent retention basin. Water and sludge in sumps was removed before station was demolished in place and covered with 5 m (16.4 ft) of fill.	D&D Facility Four concrete sumps. Capacity of ≈300,000 liters 11 x 10.4 x 9.7 m (36 x 34.1 x 31.8 ft) deep	D&D (Cummings 1987) (Encke 1989)

D&D = decontamination and decommissioning
LFI = limited field investigation

Table E2-3. Preliminary Remediation Goals.

	HUMAN-HSRAM (a,b)		PROTECTION of GROUNDWATER (a,c)	BACKGROUND (d,e)	CRQL/CRDL or as noted	(f)	ZONE SPECIFIC PRG 1 (g)	
	TR = 1E-06	HQ = 0.1					0-10 ft.	2 (h) >10 ft.
RADIONUCLIDES (pCi/g)								
Am-241	76.9	N/A	31	N/C	1		31	31
C-14	44,200	N/A	18	N/C	50		50	50
Cs-134	3,460	N/A	517	N/C	0.1	(d)	517	517
Cs-137	5.68	N/A	775	1.8	0.1	(d)	5.68	775
Co-60	17.5	N/A	1,292	N/C	0.05	(d)	17.5	1,292
Eu-152	5.96	N/A	20,667	N/C	0.1		5.96	20,667
Eu-154	10.6	N/A	20,667	N/C	0.1	(d)	10.6	20,667
Eu-155	3,080	N/A	103,000	N/C	0.1	(d)	3,080	103,000
H-3	2,900,000	N/A	517	N/C	400		517	517
K-40	12.1	N/A	145	19.7	4	(d)	19.7	145
Na-22	545	N/A	207	N/C	4	(i)	207	207
Ni-63	184,000	N/A	46,500	N/C	30		46,500	46,500
Pu-238	87.9	N/A	5	N/C	1	(d)	5	5
Pu-239/240	72.8	N/A	4	0.035	1	(d)	4	4
Ra-226	1.1	N/A	0.03	0.98	0.1	(d)	0.98	0.98
Sr-90	1,930	N/A	129	0.36	1	(d)	129	129
Tc-99	28,900	N/A	26	N/C	15		26	26
Th-228	7,260	N/A	0.1	N/C	1	(j)	1	1
Th-232	162	N/A	0.01	N/C	1		1	1
U-233/234	165	N/A	5	1.1	1	(d)	5	5
U-235	23.6	N/A	6	N/C	1	(d)	6	6
U-238 (k)	58.4	N/A	6	1.04	1	(d)	6	6
INORGANICS (mg/kg)								
Antimony	N/A	167	0.002	N/C	6		6	6
Arsenic	16.2	125	0.013	9	1	(e)	9	9
Barium	N/A	29,200	258	175	20	(e)	258	258
Cadmium	1,360	417	0.775	N/C	0.5		0.775	0.775
Chromium VI	204	2,086	0.026	28	1	(e)	28	28
Lead	N/C	N/C	8	14.9	0.3	(e)	14.9	14.9
Manganese	N/A	2,086	13	583	1.5	(e)	583	583
Mercury	N/A	125	0.31	1.3	0.02	(e)	1.3	1.3
Zinc	N/A	100000 (c)	775	79	2	(e)	775	775
ORGANICS (mg/kg)								
Aroclor 1260 (PCB)	4.34	N/A	1.37	<0.033	0.033	(e)	1.37	1.37
Benzo(a)pyrene	5	N/A	5.68	<0.330	0.330	(e)	5	6
Chrysene	N/A	N/A	0.01	<0.330	0.330	(e)	0.330	0.330
Pentachlorophenol	300	N/A	0.27	<0.8	0.8	(e)	0.8	0.8

TR=Target Risk; HQ= Hazard Quotient; N/A=Not Applicable; N/C=Not calculated; PRG=Preliminary Remediation Goal
(a) Risk-based numbers are expressed to to one significant figure.
(b) Occasional Use Scenario
(c) Based on Summer's Model (EPA 1989b)
(d) Status Report, Hanford Site Background: Evaluation of Existing Soil Radionuclide Data (Letter #008106)
(e) Hanford Site Background: Part 1, Soil Background for Nonradioacitve Analytes, DOE/RL-92-24, Rev. 2.
(f) Based on 100-BC-5 OU Work Plan QAPP (DOE-RL 1992)
(g) PRGs are established to be protective of groundwater, human and ecological receptors. The screening process used to establish PRGs for zone 1 are discussed in section 2.3 of this document.
(h) PRGs are established to be protective of groundwater. The screening process used to establish PRGs for zone 2 are ciscussed in section 2.3 of this document.
(i) Based on gross beta analysis
(j) Detection limit assumed to be same as Th-232
(k) Includes total U if no other data exist
(l) Value calculated exceeds 1,000,000 ppm therefore use 100,000 ppm as default

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Table E2-4. 116-H-7 Refined Contaminants of Potential Concern (Occasional-Use Scenario, Protection of Groundwater).

	Zone 1 (a)						Zone 2 (b)										Refined
116-H-7	0 - 3 ft		3 - 6 ft		6 - 10 ft		10 - 15 ft		15 - 20 ft		20 - 25 ft		25 - 30 ft		30 - 35 ft		COPC
	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Summary
RADIONUCLIDES (pCi/g)																	
Am-241		NO		NO	7.20E-01	NO	7.20E-01	NO		NO		NO		NO		NO	
C-14		NO		NO		NO		NO		NO		NO		NO		NO	
Cs-134	5.52E+00	NO	4.10E-01	NO	3.68E-04	NO	6.44E-04	NO		NO		NO		NO		NO	
Cs-137	**4.29E+01**	**YES**	**2.01E+03**	**YES**	**4.64E+01**	**YES**	4.29E+01	NO	5.67E+01	NO	1.52E+01	NO	1.80E+01	NO	3.53E-01	NO	YES
Co-60	**3.42E+01**	**YES**	**2.20E+03**	**YES**	**3.60E+01**	**YES**	3.60E+01	NO	2.93E+01	NO	3.66E+01	NO	2.81E+00	NO		NO	YES
Eu-152	**4.86E+02**	**YES**	**1.72E+04**	**YES**	**2.60E+02**	**YES**	2.60E+02	NO	2.08E+02	NO	1.41E+02	NO	7.07E[illegible]	NO	7.07E-02	NO	YES
Eu-154	**9.37E+01**	**YES**	**5.68E+03**	**YES**	**3.70E+01**	**YES**	3.70E+01	NO	3.69E+01	NO	3.12E+01	NO	[illegible]	NO		NO	YES
Eu-155	**8.88E+00**	NO	6.63E+02	NO	**8.13E-01**	NO	**1.18E+00**	NO	2.57E+00	NO	2.03E+00	NO	1.28E-01	NO		NO	
H-3	7.70E+00	NO	1.50E+02	NO	6.89E+00	NO	1.78E-01	NO	1.74E+01	NO		NO		NO		NO	
K-40		NO		NO		NO		NO		NO		NO		NO		NO	
Na-22		NO		NO		NO		NO		NO		NO		NO		NO	
Ni-63	1.07E+03	NO	1.79E+04	NO		NO		NO		NO		NO		NO		NO	
Pu-238	4.49E-01	NO	**6.78E+00**	**YES**	2.38E-02	NO	6.96E-02	NO	2.64E-01	NO		NO		NO		NO	YES
Pu-239/240	**1.40E+01**	**YES**	**2.00E+02**	**YES**	1.30E+00	NO	1.90E+00	NO	3.20E+00	NO	5.00E-02	NO		NO		NO	YES
Ra-226	2.90E-01	NO		NO		NO	6.50E-01	NO	6.50E-01	NO	4.40E-01	NO		NO		NO	
Sr-90	9.51E+01	NO	**2.38E+02**	**YES**	3.20E+00	NO	1.22E+01	NO	1.15E+02	NO	8.15E-01	NO	1.36E+00	NO	7.47E-01	NO	YES
Tc-99		NO		NO		NO		NO		NO		NO		NO		NO	
Th-228	4.10E-01	NO		NO		NO	8.10E-01	NO	8.10E-01	NO	4.60E-01	NO		NO		NO	
Th-232	4.10E-01	NO		NO		NO		NO	4.40E-01	NO	4.40E-01	NO		NO		NO	
U-233/234		NO		NO		NO		NO		NO		NO		NO		NO	
U-235		NO		NO	3.80E-01	NO	3.80E-01	NO		NO		NO		NO		NO	
U-238 (k)	8.30E-01	NO	4.70E+00	NO	6.80E-01	NO	6.80E-01	NO	5.30E-01	NO	5.30E-01	NO		NO		NO	
INORGANICS (mg/kg)																	
Antimony		NO		NO		NO		NO		NO		NO		NO		NO	
Arsenic	4.70E+01	YES		NO		NO		NO		NO		NO		NO		NO	YES
Barium		NO		NO		NO		NO		NO		NO		NO		NO	
Cadmium		NO		NO		NO		NO		NO		NO		NO		NO	
Chromium VI		NO		NO		NO		NO		NO		NO		NO		NO	
Lead	5.40E+02	YES		NO		NO		NO		NO		NO		NO		NO	YES
Manganese		NO		NO		NO		NO		NO		NO		NO		NO	
Mercury		NO		NO		NO		NO		NO		NO		NO		NO	
Zinc		NO		NO		NO		NO		NO		NO		NO		NO	
ORGANICS (mg/kg)																	
Aroclor 1260 (PCB)		NO		NO		NO		NO		NO		NO		NO		NO	
Benzo(a)pyrene		NO		NO		NO		NO		NO		NO		NO		NO	
Chrysene		NO		NO		NO		NO		NO		NO		NO		NO	
Pentachlorophenol		NO		NO		NO		NO		NO		NO		NO		NO	

* Maximum concentrations are screened against the PRG (preliminary remediation goal). "Yes" if the value exceeds the PRG. "No" if the value is below the PRG.
The COPC (contaminants of potential concern) are refined based on the soil concentration and the PRG.
A blank under "Max" means either no information is available or the constituent was not detected.

(a) PRGs are established to be protective of groundwater, human and ecological receptors.
(b) PRGs are established to be protective of groundwater

Sources

Dorian, J.J., and V.R. Richards, 1978, Tables 2.7-76
DOE-RL, 1993d, Tables 3-2,4, 5

116-H-7.XLS

Table E2-5. 116-H-1 Refined Contaminants of Potential Concern (Occasional-Use Scenario, Protection of Groundwater).

	Zone 1 (a)						Zone 2 (b)										Refined
116-H-1	0 - 3 ft		3 - 6 ft		6 - 10 ft		10 - 15 ft		15 - 20 ft		20 - 25 ft		25 - 30 ft		30 - 35 ft		COPC
	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Summary
RADIONUCLIDES (pCi/g)																	
Am-241		NO		NO		NO	2.00E-01	NO	1.60E-01	NO		NO		NO		NO	
C-14		NO		NO		NO		NO		NO		NO		NO		NO	
Cs-134		NO	1.75E-04	NO		NO	1.56E-04	NO		NO	1.84E-04	NO		NO		NO	
Cs-137	4.01E+02	YES	9.00E-01	NO	2.21E+01	YES	3.20E+01	NO	3.60E+02	NO	3.88E+01	NO		NO		NO	YES
Co-60	3.42E+01	YES	8.30E-02	NO	9.64E-01	NO	2.50E+00	NO	5.37E+01	NO	7.44E+00	NO		NO		NO	YES
Eu-152	5.30E+02	YES	1.28E+00	NO	2.03E+00	NO	5.40E+01	NO	9.28E+02	NO	1.11E+02	NO		NO		NO	YES
Eu-154	8.80E+01	YES	1.42E-01	NO	4.83E-01	NO	5.40E+00	NO	7.10E+02	NO	1.85E+01	NO		NO		NO	YES
Eu-155	4.49E+00	NO	5.03E-02	NO	2.35E-02	NO	7.17E-02	NO	9.95E+00	NO	8.56E-01	NO		NO		NO	
H-3		NO		NO		NO	3.93E-01	NO	2.55E-01	NO		NO		NO		NO	
K-40		NO		NO		NO		NO		NO		NO		NO		NO	
Na-22		NO		NO		NO		NO		NO		NO		NO		NO	
Ni-63		NO		NO		NO		NO		NO		NO		NO		NO	
Pu-238	2.82E-01	NO		NO		NO		NO	3.08E-01	NO		NO		NO		NO	
Pu-239/240	6.60E+00	YES		NO		NO	7.40E-01	NO	1.10E+01	YES	1.80E+00	NO		NO		NO	YES
Ra-226		NO		NO		NO		NO	8.50E-01	NO	5.50E-01	NO		NO		NO	
Sr-90	3.53E+01	NO		NO		NO	1.22E+00	NO	5.57E+01	NO	1.09E+01	NO		NO		NO	
Tc-99		NO		NO		NO		NO	6.70E-01	NO		NO		NO		NO	
Th-228		NO		NO		NO	9.50E-01	NO	7.50E-01	NO	7.50E-01	NO		NO		NO	
Th-232		NO		NO		NO		NO	8.90E-01	NO	6.40E-01	NO		NO		NO	
U-233/234		NO		NO		NO	5.30E-01	NO	6.20E-01	NO		NO		NO		NO	
U-235		NO		NO		NO		NO		NO		NO		NO		NO	
U-238 (k)		NO		NO		NO	6.10E-01	NO	3.91E-01	NO	5.80E-01	NO		NO		NO	
INORGANICS (mg/kg)																	
Antimony		NO		NO		NO		NO		NO		NO		NO		NO	
Arsenic		NO		NO		NO	3.79E+01	YES	2.76E+01	YES		NO		NO		NO	YES
Barium		NO		NO		NO		NO		NO		NO		NO		NO	
Cadmium		NO		NO		NO		NO		NO		NO		NO		NO	
Chromium VI		NO		NO		NO		NO	2.96E+01	YES		NO		NO		NO	YES
Lead		NO		NO		NO	1.87E+02	YES	1.45E+02	YES		NO		NO		NO	YES
Manganese		NO		NO		NO		NO		NO		NO		NO		NO	
Mercury		NO		NO		NO		NO		NO		NO		NO		NO	
Zinc		NO		NO		NO		NO		NO		NO		NO		NO	
ORGANICS (mg/kg)																	
Aroclor 1260 (PCB)		NO		NO		NO		NO		NO		NO		NO		NO	
Benzo(a)pyrene		NO		NO		NO		NO	8.10E-01	NO		NO		NO		NO	
Chrysene		NO		NO		NO		NO	9.20E-01	YES		NO		NO		NO	YES
Pentachlorophenol		NO		NO		NO		NO		NO		NO		NO		NO	

* Maximum concentrations are screened against the PRG (preliminary remediation goal). "Yes" if the value exceeds the PRG. "No" if the value is below the PRG.
The COPC (contaminants of potential concern) are refined based on the soil concentration and the PRG.
A blank under "Max" means either no information is available or the constituent was not detected.

(a) PRGs are established to be protective of groundwater, human and ecological receptors.
(b) PRGs are established to be protective of groundwater.

Sources
Dorian, J.J., and V.R. Richards, 1978, Tables 2.7-76
DOE-RL, 1993d, Tables 3-2,4, 5

116-H-1 XLS

Table E2-6. 100-HR-1 Waste-site Profile.
(Page 1 of 2)

Waste Site (group)	Extent of Contamination					Media/ Material	Refined COPC	Maximum Concentration Detected (a)	Are Reduced Infiltration Concentrations Exceeded?
	Volume (m^3)	Length (m)	Width (m)	Area (m^2)	Depth (m)				
116-H-7 (retention basin)	56483.0	201.8	93.3	18828.0	3.0	Soil Concrete	Radionuclides	pCi/g	
							^{60}Co	2.20×10^3	NO
							^{137}Cs	2.01×10^3	NO
							^{152}Eu	1.72×10^4	NO
							^{154}Eu	5.68×10^3	NO
							^{238}Pu	6.78	NO
							$^{239/240}Pu$	2.00×10^2	NO
							^{90}Sr	2.38×10^2	NO
							Inorganics	mg/kg	
							Arsenic	4.7×10^1	YES
							Lead	5.40×10^2	NO
116-H-1 (process effluent trench)	12,015.0	58.8	33.5	1970.0	6.1	Soil	Radionuclides	pCi/g	
							^{60}Co	3.42×10^1	NO
							^{137}Cs	4.01×10^2	NO
							^{152}Eu	5.30×10^2	NO
							^{154}Eu	8.8×10^1	NO
							$^{239/240}Pu$	1.1×10^1	NO
							Inorganics	mg/kg	
							Arsenic	3.79×10^1	YES
							Chromium	2.96×10^1	YES
							VI	1.87×10^2	NO
							Lead		
								ppb	
							Organics	9.20×10^2	NO
							Chrysene		
116-H-4 (pluto crib)	0.0	0.0	0.0	0.0	0.0	NA	None	NA	NA

Table E2-6. 100-HR-1 Waste-site Profile. (Page 2 of 2)

Waste Site (group)	Extent of Contamination					Media/ Material	Refined COPC	Maximum Concentration Detected (a)	Are Reduced Infiltration Concentrations Exceeded?
	Volume (m^3)	Length (m)	Width (m)	Area (m^2)	Depth (m)				
100 H pipeline (Pipeline)	(b)	(b)	(b)	(b)	(b)	Steel Concrete	Radionuclides ^{60}Co ^{137}Cs ^{152}Eu ^{154}Eu ^{155}Eu ^{63}Ni ^{238}Pu $^{239/240}Pu$ ^{90}Sr	assume data from pipeline group	NO(c)
132-H-1 Reactor Exhaust Stack (D&D facility)	0.0	0.0	0.0	0.0	0.0	NA	None	NA	NA
132-H-2 Filter Building (D&D facility)	0.0	0.0	0.0	0.0	0.0	NA	None	NA	NA
132-H-3 Effluent Pumping Station (D&D facility)	0.0	0.0	0.0	0.0	0.0	NA	None	NA	NA

(a) Where concentration exceeds preliminary remediation goals.
(b) No contaminated soil is associated with the site; therefore, no volume of contamination is calculated; extent of contamination is limited to the pipeline itself.
(c) Based on group data.
COPC = contaminants of potential concern
NA = not applicable
D&D = decontamination and decommissioning

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Table E2-7. Allowable Soil Concentration - Reduced Infiltration Scenario.

Analyte	Soil Concentration
RADIONUCLIDES	**pCi/g**
^{241}Am	$5.01(10^{3})$
^{14}C	$2.92(10^{3})$
^{134}Cs	$8.35(10^{4})$
^{137}Cs	$1.25(10^{5})$
^{60}Co	$2.09(10^{5})$
^{152}Eu	$3.34(10^{6})$
^{154}Eu	$3.34(10^{6})$
^{155}Eu	$1.67(10^{7})$
^{3}H	$8.35(10^{4})$
^{40}K	$2.34(10^{4})$
^{22}Na	$3.34(10^{4})$
^{63}Ni	$7.52(10^{6})$
^{238}Pu	$8.35(10^{2})$
$^{239/240}Pu$	$6.27(10^{2})$
^{226}Ra	$4.00(10^{0})$
^{90}Sr	$2.09(10^{4})$
^{99}Tc	$4.18(10^{3})$
^{228}Th	$1.67(10^{1})$
^{232}Th	$2.09(10^{0})$
$^{233/234}U$	$8.35(10^{2})$
^{235}U	$1.00(10^{3})$
^{238}U	$1.00(10^{3})$
INORGANICS	**mg/kg**
Antimony	$2.51(10^{-1})$
Arsenic	$2.09(10^{0})$
Barium	$4.18(10^{4})$
Cadmium	$1.25(10^{2})$
Chromium (VI)	$4.18(10^{0})$
Lead	$1.25(10^{3})$
Manganese	$2.09(10^{3})$
Mercury	$5.01(10^{1})$
Zinc	$1.25(10^{5})$
ORGANICS	**mg/kg**
Aroclor 1260	$2.21(10^{2})$
Benzo(a)pyrene	$9.19(10^{2})$
Chrysene	$2.00(10^{0})$
Pentachlorophenol	$4.40(10^{1})$

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3.0 RESULTS OF THE PLUG-IN APPROACH

This section provides the "plug-in" (Section 1.4 of the Process Document) approach as applied to the interim remedial measures candidate sites in the 100-HR-1 Operable Unit. The plug-in approach requires identification of the waste site group to which a waste site belongs and an evaluation of the alternate applicable criteria.

Identification of the waste site group to which each waste site belongs is accomplished by using the waste site descriptions defined in Section 2.0 and fitting the site into the appropriate waste site group in Figure 1-4 of the Process Document. It is also necessary to refer to the group descriptions defined in Section 3.0 of the Process Document. The appropriate group for each site is identified in Table E3-1.

Table E3-1 presents the evaluation of the alternative applicability criteria for each interim remedial measures waste site. The evaluation represents step 6 of the plug-in approach (Section 1.4 of the Process Document) and identifies which alternatives and enhancements apply to each site. Any deviation from alternatives developed for the appropriate group in the Process Document are identified by footnote. Sites with deviations will be developed further in subsequent sections; however, the general analysis of alternatives in the Process Document (Section 5.0) will be used for sites without deviations.

The deviations indicated in Table E3-1 are briefly summarized as follows:

- Waste site 116-H-7 retention basin has contamination <5.8-m (19-ft) thick; therefore, In Situ Vitrification does apply.
- Waste site 116-H-1 process effluent trench has contamination that is >5.8-m (19-ft) thick; therefore, In Situ Vitrification does not apply. Also, because organic contaminants are present, thermal desorption will be added as an enhancement to the treatment alternative.
- Waste site 100-H buried pipelines are not known to have soil contamination associated with them; therefore, soil treatment is not applicable.
- Waste site 116-H-4 pluto crib was removed and buried in waste site 118-H-5 burial ground in the past; therefore, no action is warranted at the site.

3.1 EXAMPLE APPLICATION OF THE PLUG-IN APPROACH (116-H-7)

To achieve a further understanding of the plug-in approach (Section 1.4 of the Process Document), an example of its application has been developed. The example, waste site 116-H-7, will be evaluated as dictated by the plug-in approach. The waste-site profile has been defined in Section 2.0 (completing step 4 of the approach). Steps 5 and 6 of the approach are completed below.

3.1.1 Identification of Appropriate Group

Waste site 116-H-7 retention basin is assessed against the elements of Figure 1-4 of the Process Document to ensure that the appropriate group is identified.

Table E2-2 does not indicate that the site received solid waste, and states that the site held cooling water effluent from H Reactor for short-term cooling/decay before release to the Columbia River. This indicates that it is a contaminated soil site used for liquid effluent transfer. Table E2-2 does indicate that the site is a reinforced concrete retention basin. It can be concluded that the appropriate group for waste site 116-H-7 is the retention basins. The profile for the group and the associated detailed and comparative analyses are documented in the Process Document.

3.1.2 Evaluation of the Alternative Applicability Criteria

Based on the description and profile developed for waste site 116-H-7 in Section 2.0, an evaluation of the alternative applicability criteria can be accomplished. The evaluation of each alternative is presented below.

No Action - There are data indicating contamination present at the site that warrants an interim action. Therefore, no action is not an appropriate alternative.

Institutional Controls - Refined COPC are identified for waste site 116-H-7 in Table E2-3 indicating that there are contaminants present that exceed preliminary remediation goals. Therefore, institutional controls will not effectively address contaminants at the site.

Containment - Because there are contaminants that exceed reduced infiltration concentrations at waste site 116-H-7, containment will not be applicable at the site.

Removal/Disposal - Because contaminants exceed preliminary remediation goals, this alternative may be applicable.

In Situ Treatment - Because contaminants exceed preliminary remediation goals, and the contaminated lens is <5.8 m (19 ft), the In Situ treatment option may be applicable.

Removal/Treatment/Disposal - Because contaminants exceed preliminary remediation goals, this alternative may be applicable. Thermal desorption enhancement is not necessary because organic contaminants are not present at the site. For cost purposes, it was assumed that the percentage of contaminated soil that can be effectively treated by soil washing is 33% of the 116-H-7 waste site. This percentage was based on the depth, distribution, and concentration of contaminants at the waste site. This does not affect the application of the alternative, but does impact the magnitude of volume reduction realized at the site.

This evaluation resulted in identifying applicable alternatives. These results are compared to the results of the group analysis presented in Table E5-1 of the Process Document to identify deviations.

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	116-H-7 Alternatives	Group Alternatives
Applicable	Removal/Disposal In Situ Treatment Removal/Treatment/Disposal - no enhancements	Removal/Disposal Removal/Treatment/Disposal - no enhancements
Not Applicable	No Action Institutional Controls Containment	No Action Institutional Controls Containment In Situ Treatment

The alternatives for waste site 116-H-7 are not the same as those for the retention basin group; therefore, deviations are identified and the site does not completely plug into the analyses for the group. The deviation is with respect to the In Situ treatment alternative. Contrary to the retention basin group, waste site 116-H-7 has a lens of contamination that is <5.8 m (19 ft); therefore, In Situ Vitrification may be applicable at the site.

Table E3-1. Comparison of Waste Sites to Remedial Alternatives. (page 1 of 2)

Waste Site Group		116-H-7 Retention Basin	116-H-1 Process Effluent Trench	PIPELINES Buried Pipeline	116-H-4 Pluto Crib	132-H-1 132-H-2 132-H-3 Decontamination and Decommissioning
Alternative	**Applicability Criteria and Enhancements**	**Are Applicability Criteria and Enhancements Met?**				
No Action						
SS-1 SW-2	Criterion: • Has site been effectively addressed in the past?	No	No	No	Yes (d)	Yes
Institutional Controls						
SS-2 SW-2	Criterion: • Contaminants < PRG	No	No	No	NA	NA
Containment						
SS-3 SW-3	Criteria: • Contaminants > PRG	Yes	Yes	Yes	NA	NA
	• Contaminants < reduced infiltration concentrations	No	No	Yes	NA	NA
Removal/Disposal						
SS-4 SW-4	Criterion: • Contaminants > PRG	Yes	Yes	Yes	NA	NA
In Situ Treatment						
SS-8A	Criteria: • Contaminants > PRG	Yes	Yes	NA	NA	NA
	• Contamination < 5.8 m (19 ft) in depth	Yes(d)	No(d)	NA	NA	NA
SS-8B	Criteria: • Contaminants > PRG	NA	NA	Yes	NA	NA
	• Contaminants < reduced infiltration concentrations	NA	NA	Yes	NA	NA
SW-7	Criteria: • Contaminants > PRG	NA	NA	NA	NA	NA
	• Contaminants < reduced infiltration concentrations	NA	NA	NA	NA	NA

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Table E3-1. Comparison of Waste Sites to Remedial Alternatives. (page 2 of 2)

Waste Site / Group		116-H-7 Retention Basin	116-H-1 Process Effluent Trench	PIPELINES Buried Pipeline	116-H-4 Pluto Crib	132-H-1 132-H-2 132-H-3 Decontamination and Decommissioning
Alternative	**Applicability Criteria and Enhancements**	**Are Applicability Criteria and Enhancements Met?**				
Removal/Treatment/Disposal						
SS-10	Criterion: • Contaminants > PRG	Yes	Yes	NA(d)	NA	NA
	Enhancements: • Organic contaminants (if yes, thermal desorption must be included in the treatment system)	No	Yes(d)	NA(d)	NA	NA
	• Percentage of contaminated volume less than twice the PRG for cesium-137.	33%	33%	NA(d)	NA	NA
SW-9	Criterion: • Contaminants > PRG	NA	NA	NA	NA	NA
	Enhancement: • Organic contaminants	NA	NA	NA	NA	NA

NA - not applicable
(d) - deviation from waste site group
PRG - preliminary remediation goals

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4.0 ALTERNATIVE DEVELOPMENT

This section identifies those waste sites in the 100-HR-1 Operable Unit that match completely with their corresponding waste site group in the Process Document; and those waste sites that don't match.

For those sites that match completely, the site plugs directly into the analysis of alternatives for the waste site group conducted in the Process Document (see Section 1.4, Step 6a). The waste sites that meet this requirement are 132-H-1, 132-H-2, and 132-H-3.

The sites that do not plug in directly (Process Document, Section 1.4, Step 6b) can be divided into two groups. The first group contains those sites that require enhancements to an alternative or an inclusion or dismissal of an alternative as originally proposed. These sites are discussed in the bullets that follow. However, the enhancements do not need development for these sites, because the Process Document incorporates the appropriate enhancements in Section 1.4.

- The 116-H-4 pluto crib does not meet the applicability criteria for the pluto crib group alternatives identified in the Process Document. Because this site was excavated and material buried in waste site 118-H-5 (decontamination and decommissioning), contamination is believed to no longer exist at the site. Therefore, this site meets the applicability criteria for the No Action Alternative. Accordingly, this site deviates from the group because of a change in the applicable alternatives.

- The 116-H-1 process effluent trench requires thermal desorption as an enhancement option (because of the presence of organic contamination) to the Removal/Treatment/Disposal Alternative. Additional development of the technology and alternative are not required because the Process Document discusses thermal desorption as a treatment enhancement. Waste site 116-H-1 does not meet the applicability criteria for In Situ Vitrification (unlike the process effluent trench waste site group).

- The 116-H-7 retention basin does meet the applicability criteria for the In Situ treatment alternative because of its relatively shallow depth of contamination. Therefore, this site deviates from the retention basin group. However, this deviation does not require additional development of technologies or alternatives.

- Buried pipelines in the 100-HR-1 Operable Unit have no identified contaminated soils associated with them; therefore, the Removal/Treatment/Disposal Alternative does not apply. This is a deviation from the group; therefore, this site does not require additional development of technologies or alternatives.

The second group of sites which do not plug in, are those sites that require a significant modification to an alternative, such as changes in the excavation process or disposal options. Alternatives for sites included in this second set require additional development in the next section of this Appendix. None of the sites within the 100-HR-1 Operable Unit fit into this second set; therefore additional alternative development is not required.

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5.0 DETAILED ANALYSIS OF ALTERNATIVES

This section presents the detailed analysis of the remedial alternatives for the four individual waste sites within the 100-HR-1 Operable Unit that require further analyses (i.e., do not plug into Process Document). In the detailed analysis, each alternative is assessed against the evaluation criteria described in Section 5.1 of the Process Document. The detailed analysis provides a basis to compare the alternatives and support a subsequent evaluation of the alternatives made by the decision makers in the remedy selection process.

The detailed analysis for the sites within the 100-HR-1 Operable Unit are presented in the following manner:

- The detailed analyses for those individual waste sites that do not deviate from the waste site groups are referenced to the group discussion presented in the Process Document.
- The detailed analyses for those individual waste sites that deviate from the waste site groups are discussed in Section 5.2.

5.1 SITE-SPECIFIC COMMON EVALUATION CONSIDERATIONS

Based on the comparison presented in Table E3-1, several of the individual waste sites within the 100-HR-1 Operable Unit plug into the waste site group alternatives; therefore, the common evaluation considerations for these individual waste sites can be found in the Process Document. These individual waste sites include 132-H-1, 132-H-2, and 132-H-3.

The common evaluation considerations for the remaining waste sites (116-H-7, 116-H-1, 116-H-4, and 100-H pipelines) are discussed in the following sections. Each deviation of a Process Document alternative for these waste sites is analyzed for impacts to transportation, air quality, ecological, cultural, socioeconomic, noise and visual resources. In addition to identifying those potential impacts, irretrievable and irreversible commitment of resources, indirect and cumulative impacts, and compliance with Executive Order 12898 are also discussed.

5.1.1 116-H-7 Retention Basin

This section evaluates the alternatives that deviate from the Process Document for waste site 116-H-7 retention basin. Alternatives SS-4, SS-8A, and SS-10 are applicable to this site. However, only Alternative SS-8A deviates from the Process Document and therefore will be evaluated.

Alternative SS-8A, In Situ Vitrification of contaminated soil, would impact transportation. This alternative would require the transport of equipment, solid waste from operations, and importing clean fill after treatment by truck on site. The commuter traffic associated with this alternative would not be expected to cause a noticeable impact in the Tri-Cities area or on the Hanford Site.

Implementation of Alternative SS-8A for the 116-H-7 retention basins would not impact air quality in the short-term. The 116-H-7 retention basins are not known to have any organic contamination, so the emission of organic compounds during vitrification would not be a problem. Mitigative measures would be employed as needed to ensure that short-term impacts on air quality are minor and acceptable.

In Situ Vitrification of the contaminated soil at the 116-H-7 retention basins would not impact ecological resources. This area has been disturbed by former reactor operations and presently has very little ecological value. Revegetation and restoration efforts subsequent to In Situ Vitrification would in the long-term benefit natural resources.

Impacts from remediation to cultural resources co-located with the retention basins would generally be minimized by this alternative. The potential of this alternative for disturbing cultural resources is considered low. However, contaminated cultural resources would be a continuing source of concern to Native American communities.

The socioeconomic impact of this alternative would be insignificant. The number of employees involved and the income gained would be insignificant when compared with the total Tri-Cities area employment. Workers would likely come from the regional labor force. So, consistent with overall employment, income and population impact effects on housing would be insignificant.

This alternative would create minor short-term impacts to noise and visual resources. Some impact to 100 Area noise levels may occur during the In Situ treatment process. Noise mitigation would be provided should noise levels become a problem. To mitigate potential impacts to visual resources, dust controls and backfilling with clean soil and contouring and revegetating would be implemented when needed.

This alternative would result in commitment of land-to-waste management. Institutional controls and monitoring would be required. Resources, such as federal funds, soil cover, and consumables, such as fuel, electricity, chemicals, and personal protective equipment, would be irreversibly committed.

The indirect impact of this alternative would be enhancement of the natural resources through revegetation of remediated waste sites. This alternative could add to the cumulative impact on transportation, ecological, noise, and visual resources from Hanford Site remediation.

As stated in the Process Document in Section 5.2.6.5, this alternative would comply with Executive Order 12898, Environmental Justice, because it would not disproportionately affect any group of the population more than another.

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5.1.2 116-H-1 Process Effluent Trench

This section evaluates the alternatives that deviate from the Process Document for the 116-H-1 process effluent trench site. Alternatives SS-4 and SS-10 are applicable to this site. However, only Alternative SS-10 deviates from the Process Document, and therefore, will be evaluated.

Alternative SS-10, which includes thermal desorption, would impact transportation. This alternative would require the transport of equipment, contaminated and solid waste, and clean fill by truck on site. The commuter traffic flow for this alternative would be considered an impact in the 100 Area.

The thermal desorption included in this alternative may impact air quality. Organics present at waste site 116-H-1 may be emitted during the thermal desorption process. However, mitigative measures would be employed as needed to ensure that these potential short-term impacts on air quality are minor and acceptable.

Excavation, soil treatment, and disposal of the remaining contaminated soil would have a short-term impact on wildlife as a result of increased human activities, traffic, noise, and fugitive dust. Mitigation measures would be implemented to limit these impacts. Alternative SS-10 would remove contaminants from the area, and the subsequent revegetation and restoration efforts would, in the long term, benefit natural resources.

The potential of this alternative, for disturbing cultural resources, is considered high. Actions to mitigate adverse impacts on significant cultural resources must be taken before implementing this alternative.

The socioeconomic impact of this alternative would be insignificant. The number of employees involved and the income gained would be insignificant when compared with the total Tri-Cities area employment. Workers would likely come from the regional labor force. Consistent with overall employment, income, and population impact effects on housing would be insignificant.

This alternative would create minor short-term impacts to noise and visual resources during the treatment process. Noise mitigation would be provided should noise levels become a problem. To mitigate potential impacts to visual resources, dust controls and backfilling with clean soil then contouring and revegetating would be implemented when needed.

Resources such as federal funds, soil cover; and consumables such as fuel, electricity, chemicals, and personal protective equipment would be irreversibly committed.

The indirect impact of this alternative would be an enhancement of the natural resources through revegetation. This alternative could add to the cumulative impact on transportation and cultural, noise and visual resources from Hanford Site remediation.

As stated in the Process Document, this alternative may comply with Executive Order 12898, Environmental Justice. Excavation always poses the risk of unearthing Native American burials. This risk of an adverse impact on Native American cultural resources may be disproportionately large compared to other segments of the population. This alternative may protect groups of the population with higher fish consumption patterns than the general population from contamination at the 116-H-1 process effluent trench.

5.1.3 116-H-4 Pluto Crib

Because of the elimination of contamination (through previous excavation and removal) only the No Action Alternative (SS-1) applies to the 116-H-4 pluto crib site. The deviation for this site is just an omission of alternatives; no evaluation is required.

5.1.4 Buried Pipelines

The Removal/Treatment/Disposal Alternative (SS-10) is applicable to sites that have contaminated soil. Current documentation indicates that the soil surrounding the 100-HR-1 pipelines is not contaminated (Dorian and Richards 1978). Therefore, the soil surrounding the pipelines is not anticipated to require remedial action. The deviation for this site is just an omission of an alternative; no evaluation is required.

5.2 SITE-SPECIFIC DETAILED ANALYSIS

Based on the comparison presented in Table E3-1, several of the individual waste sites within the 100-HR-1 Operable Unit plug into the waste site group alternatives; therefore, the detailed analysis for these individual waste sites can be referenced to the Process Document. These individual waste sites include 132-H-1, 132-H-2, and 132-H-3.

The detailed analysis for the remaining waste sites (116-H-7, 116-H-1, 116-H-4, and 100-H pipelines) are discussed in the following sections. Table E5-1 summarizes the Remedial Alternatives applicable to each waste site and shows whether the detailed analysis is covered in the Process Document or discussed in this document. Tables E5-2 and E5-3 present the remediation costs and durations, respectively, associated with all waste sites.

5.2.1 116-H-7 Retention Basin

This section evaluates the alternatives that deviate from the Process Document for the 116-H-7 retention basin site against the CERCLA evaluation criteria. Alternatives SS-4, SS-8A, and SS-10 are applicable to this site. However, only Alternative SS-8A deviates from the Process Document, and therefore, will be evaluated.

5.2.1.1 Overall Protection of Human Health and the Environment. Alternative SS-8A involves In Situ Vitrification to thermally treat organic contaminants and immobilize inorganic contaminants applicable to the 116-H-7 retention basin. Alternative SS-8A will eliminate the human health and ecological pathways in approximately 8.1 years. Workers will not be exposed to contaminants during implementation.

5.2.1.2 Compliance with ARAR. Chemical-specific ARAR for Alternative SS-8A will be met by thermal destruction and encapsulation of contaminants in the soil. Location-specific ARAR can be met through proper planning and scheduling. Action-specific ARARs are met through appropriate design and operation.

5.2.1.3 Long-term Effectiveness and Permanence. The magnitude of the remaining risk for Alternative SS-8A is expected to be minimal because of the anticipated characteristics of the vitrified material and the soil cover. Sources of risk remain; however, In Situ Vitrification will eliminate all exposure pathways. Long-term management in the form of institutional controls and groundwater surveillance monitoring is required. Also, maintenance of the soil cover overlying the vitrified material may be needed.

5.2.1.4 Reduction of Toxicity, Mobility, or Volume. In Situ Vitrification is an irreversible process that will treat all of the contaminated soil to the maximum melt depth, effectively immobilizing the contaminants in the glass melt. Hydraulic infiltration is temporarily reduced and mobilization is eliminated. There will be minimal quantities of residuals from offgas treatment as condensate and contaminated filters. However, these can be disposed of directly into the melt. The principal exposure pathways at the site are eliminated.

5.2.1.5 Short-term Effectiveness. Risks to the community and workers during In Situ Vitrification include potential releases of fugitive dusts and gases. These releases can be controlled through proper operating procedures. No receptors are currently in the area. However, remedial activities can be scheduled to accommodate nesting or roosting species if encountered. All remedial action objectives are met upon completion of a Remedial Alternative.

5.2.1.6 Implementability. Some difficulties are associated with the implementation of In Situ Vitrification. Some investigation may be required to locate the area proposed for treatment. In addition, soil particle sizes may vary from site to site. Existence of cobble layers and structural members may affect performance. It is very unlikely that technical problems will lead to schedule delays. All necessary equipment and specialists are readily available. Long-term deed restrictions may require coordination with state groundwater agencies and with local zoning authorities.

5.2.2 116-H-1 Process Effluent Trench

This section evaluates the alternatives that deviate from the Process Document for the 116-H-1 process effluent trench site against the CERCLA evaluation criteria. Alternatives SS-4 and SS-10 are applicable to this site. However, only Alternative SS-10 deviates from the Process Document, and therefore, will be evaluated. Alternative SS-8A is applicable to the process effluent trench group, but was eliminated for 116-H-1 in the evaluation of the alternative applicability criteria in Section 3.2.

5.2.2.1 Overall Protection of Human Health and the Environment. Based on the presence of organics, Alternative SS-10 requires that thermal desorption be included for this waste site. The removal/treatment/disposal technologies associated with Alternative SS-10 will result in protectiveness of human health and the environment regardless of the additional treatment by thermal desorption. Any additional short-term risk to the workers or the community can be minimized through engineering controls and proper health and safety protocol.

5.2.2.2 Compliance with ARAR. Chemical-specific ARAR for Alternative SS-10 will be met by desorption of organic compounds from the soil. Location-specific ARARs can be met through proper planning and scheduling. Action-specific ARARs are met through appropriate design and operation.

5.2.2.3 Long-term Effectiveness and Permanence. The addition of thermal desorption to Alternative SS-10 does not change the analysis of this alternative with respect to this criterion from the Process Document. Contaminated soil exceeding preliminary remediation goals will be permanently removed from the site.

5.2.2.4 Reduction of Toxicity, Mobility, or Volume. Thermal desorption is primarily an irreversible process in which nearly all of the volatile and semivolatile constituents will be reduced. Any of the remaining volatile and semivolatile organic contaminants will be rendered immobile. Thermal desorption may completely reduce the volume of soil, producing minimal amounts of residuals that will be transferred to a disposal facility.

5.2.2.5 Short-term Effectiveness. Risks to the community and workers during thermal desorption include potential releases of fugitive gases. These releases can be controlled through vapor abatement and proper operating procedures. No receptors are currently in the area. However, remedial activities can be scheduled to accommodate nesting or roosting species if encountered. All remedial action objectives are met upon completion of Remedial Alternative.

5.2.2.6 Implementability. No difficulties are anticipated with the implementation of thermal desorption despite the absence of site-specific treatability study data. An influent soil particle size limitation of 2-in. exists. It is very unlikely that technical problems will lead to schedule delays. All necessary equipment and specialists are readily available and adjustments to Alternative SS-10 are easily accomplished as thermal desorption will be an off-line process. Because of removal, post closure monitoring will not be required.

5.2.3 116-H-4 Pluto Crib

This section evaluates the alternatives that deviate from the Process Document for the 116-H-4 pluto crib sites against the CERCLA evaluation criteria. Because of the elimination of contamination (through previous excavation and removal) only Alternative SS-1 applies, and therefore, no evaluation is required.

5.2.4 Buried Pipelines

This section evaluates the 100-HR-1 pipeline sites against the CERCLA evaluation criteria. The Removal/Treatment/Disposal Alternative (SS-10) is applicable to sites that have contaminated soil. Current documentation indicates that the soil surrounding the 100-HR-1 pipelines is not contaminated (Dorian and Richards 1978). Therefore, the soil surrounding the pipelines will not require remedial action. Because the deviation for this site is just an omission of an alternative, no evaluation is required.

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Table E5-1. Waste Site Remdial Alternatives and Technologies.

Alternatives		Technologies Included	Waste Site Group				
			116-H-7 Retention Basin	116-H-1 Process Effluent Trench	Buried Pipelines	116-H-4 Pluto Crib	132-H-1 132-H-2 132-H-3
No Action	SS-1 SW-1	None				O	P
Institutional Controls	SS-2 SW-2	Deed Restrictions					
		Groundwater Monitoring					
Containment	SS-3 SW-3	Surface Water Controls			P		
		Modified RCRA Barrier			P		
		Deed Restrictions			P		
		Groundwater Monitoring			P		
Removal, Disposal	SS-4 SW-4	Removal	P	P	P		
		Disposal	P	P	P		
In Situ Treatment	SS-8A	Surface Water Controls	O				
		In Situ Vitrification	O				
		Groundwater monitoring	O				
		Deed restrictions	O				
	SS-8B	Void Grouting			P		
		Modified RCRA Barrier			P		
		Surface Water Controls			P		
		Deed Restrictions			P		
		Groundwater Monitoring			P		
	SW-7	Dynamic Compaction					
		Modified RCRA Barrier					
		Surface Water Controls					
		Groundwater Monitoring					
		Deed Restrictions					
Removal, Treatment, Disposal	SS-10	Removal	P	P			
		Thermal Desorption		P,O			
		Soil Washing	P	P			
		Disposal	P	P			
	SW-9	Removal					
		Thermal Desorption					
		Compaction					
		ERDF Disposal					

Note: P - Indicates the detailed analysis which is provided in the Process Document
O - Indicates the detailed analysis which is provided in the operable unit-specific report
blank - Technology does not apply to this Waste Site
RCRA - Resource Conservation and Recovery Act
ERDF - Environmental Restoration Disposal Facility

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Table E5-2. 100-HR-1 Waste Site-Specific Alternative Costs.

Site	Containment			Removal / Disposal			In Situ Treatment			Removal / Treatment / Disposal		
	Capital	O&M	Present Worth	Capital	O&M	Present Worth	Capital	O&M	Present Worth	Capital	O&M	Present Worth
100-HR-1 OPERABLE UNIT												
116-H-7 Retention Basin				$29.4M	$0	$28M	$66.9M	$54.9M	$98.0M	$31.9M	$4.05M	$34.2M
116-H-1 Process Effluent Trench				$6.08M	$0	$5.79M				$6.53M	$.825M	$7.02M
116-H-4 Pluto Crib	No interim action proposed at site											
100H PIPELINES	$9.76M	4.64M	$11.9M	$2.27M	$0.0	$2.16M	$.942M	$0.0	$.898M			
132-H-1 Reactor Exhaust Stack	No interim action proposed at site											
132-H-2 Exhaust Air Filter Building	No interim action proposed at site											
132-H-3 Effluent Pumping Station	No interim action proposed at site											

Blank Cell = Not Applicable
O&M = Operation and Maintenance
M = million

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Table E5-3. 100-HR-1 Waste Site-Specific Alternative Durations.

SITE	Containment	Removal/Disposal	In Situ Treatment	Removal/Treatment/Disposal
	Duration (yrs)	Duration (yrs)	Duration (yrs)	Duration (yrs)
100-HR-1 OPERABLE UNIT				
116-H-7 Retention Basin		0.5	8.1	1.0
116-H-1 Process Effluent Trench		0.2		0.2
116-H-4 Pluto Crib	No interim action proposed at site			
100 H PIPELINES	0.5	0.3	0.1	
118-H-5 Burial Ground	Institutional Controls proposed at site			
132-H-1 Reactor Exhaust Stack	No interim action proposed at site			
132-H-2 Exhaust Air Filter Building	No interim action proposed at site			
132-H-3 Effluent Pumping Station	No interim action proposed at site			

Blank Cell = Not Applicable

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6.0 COMPARATIVE ANALYSIS

This section presents the comparative analysis of Remedial Alternatives, which involves evaluation of the relative performance of each alternative with respect to the evaluation criteria presented in Section 5.0. This comparison identifies the advantages and disadvantages of each alternative so that key tradeoffs can be identified.

Following the methodology of the Process Document, the comparative analysis of the 100-HR-1 alternatives is presented in tabular format (Tables E6-1 through E6-3). The tables present the alternatives applicable to each waste site and a comparison of the relative differences between each alternative. The comparison consists of identifying the relative rank of the alternative (relative to other applicable alternatives) along with the cost[1], and a discussion of the specific advantages and disadvantages of each alternative. The quantitative comparison tables rank each alternative as well as provide separate rankings for the five criteria evaluated.

6.1 QUANTITATIVE COMPARISON OF REMEDIAL ALTERNATIVES

6.1.1 116-H-7 Retention Basin

The 116-H-7 retention basin does meet the applicability criteria for the In Situ Vitrification Treatment Alternative because of its relatively shallow depth of contamination (unlike the retention basin group presented in the Process Document).

The addition of In Situ Vitrification as a treatment alternative results in the need to reexamine the comparative analysis performed in the Process Document. The Removal/Disposal and Removal/Treatment/Disposal Alternatives evaluated for retention basins in the Process Document applies directly to the 116-H-7 retention basin. In Situ Vitrification for the retention basin follows the same philosophy, detailed evaluation, and comparative analysis, as was performed for the other waste sites that included ISV. The only factor that resulted in variations to the scoring for different waste sites is the size of the excavation. The long-term effectiveness, reduction in toxicity, mobility, and volume through treatment, and short-term effectiveness all remain the same score as was given to the other waste sites (a 4, 7, and 7, respectively). A score of 2 was given to the retention basins for implementability because of the large area to be vitrified. As a result, Removal/Disposal is the highest ranking option followed by Removal/Treatment/Disposal and then In Situ Vitrification.

6.1.2 116-H-1 Process Effluent Trench

The elimination of ISV for the 116-H-1 Process Effluent Trench leaves the two Remedial Alternatives to be evaluated as Removal/Disposal and Removal/Treatment/Disposal. The addition of thermal desorption to the treatment process

[1]Estimates of durations for each alternative are presented in Section 5.0, Table E5-2.

increases the score for the Reduction in Toxicity, Mobility, and Volume through Treatment by one point. The additional process slightly reduces the short-term effectiveness and implementability categories. This reduction is so slight that a reduction in the score originally given to these categories is not warranted. However, as can be seen in the scoring of the cost category, a reduction in score in the cost category by one point is required.

6.1.3 116-H-4 Pluto Crib

The 116-H-4 pluto crib site was excavated from its original location in 1960. The excavation debris was then buried in the 118-H-5 burial ground to accommodate the construction of the 132-H-2 filter building. (The 118-H-5 burial ground will be addressed as part of the 100-HR-2 Operable Unit.) No contaminants of concern were identified at the 116-H-4 pluto crib site; therefore, the No Action Alternative is the preferred alternative. The No Action Alternative meets all CERCLA criteria evaluated for action alternatives for this waste site. The 116-H-4 pluto crib will be addressed as part of future remedial actions for the 100-HR-1 Operable Unit.

6.1.4 100-H Buried Pipelines

The reason for eliminating the treatment option for Removal/Treatment/Disposal Alternative is the lack of contaminated soils around the buried pipelines. This lack of contaminated soil has its benefits from a cost and environmental cleanup perspective, but increases the difficulties for short-term effectiveness and implementability from the need to create staging areas and double handling of the clean fill that would be placed back into the hole. As a result, the score for these two categories have been reduced by one point. This results in Removal/Disposal to still be the highest ranking alternative, but In Situ Grouting is now less than one point behind the Removal/Disposal Alternative.

Table E6-1. Quantitative Comparison of Evaluation Criteria for 116-H-7 Retention Basin.

CERCLA Evaluation Criteria	Remedial Alternatives								
	Removal/Disposal			In Situ Vitrification			Removal/Treatment/Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	7.00	7.00	00	4.00	4.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	4.00	2.00	0.50	7.00	3.50	0.50	5.00	2.5
Short-term Effectiveness	0.50	6.00	3.00	0.50	7.00	3.50	0.50	3.00	1.50
Implementability	1.00	9.00	9.00	.00	2.00	2.00	1.00	5.00	5.00
Cost	1.00	10.00	10.00	.00	3.00	3.00	1.00	8.00	8.00
Total Rank[b]			31.0			16.00			26.0

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

Table E6-2. Quantitative Comparison of Evaluation Criteria for 116-H-1 Process Effluent Trenches.

CERCLA Evaluation Criteria	Remedial Alternatives					
	Removal/Disposal			Removal/Treatment/ Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	7.00	7.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	3.00	1.5	0.50	5.00	2.5
Short-term Effectiveness	0.50	7.00	3.50	0.50	3.00	1.50
Implementability	1.00	7.00	7.00	1.00	5.00	5.00
Cost	1.00	10.00	10.00	1.00	8.00	8.00
Total Rank[b]			29.0			26.0

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

Table E6-3. Quantitative Comparison of Evaluation Criteria for 100-H Buried Pipelines.

CERCLA Evaluation Criteria	Remedial Alternatives								
	Containment			Removal/Disposal			In Situ Grouting		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	2.00	2.00	1.00	7.00	7.00	1.00	3.00	3.00
Reduction of Mobility or Volume	0.50	1.00	0.50	0.50	3.00	1.50	0.50	2.00	1.0
Short-term Effectiveness	0.50	7.00	3.50	0.50	6.00	3.00	0.50	6.00	3.00
Implementability	1.00	3.00	3.00	1.00	7.00	7.00	1.00	2.00	2.00
Cost	1.00	1.00	1.00	1.00	4.00	4.00	1.00	10.00	10.00
Total Rank[b]			10.0			22.5			19.0

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

7.0 COMPARATIVE ANALYSIS FOR REVISED FREQUENT USE SCENARIO

As discussed in the introduction of this Appendix, the detailed and comparative analyses performed in Sections 5.0 and 6.0 of the Process Document and this FFS Appendix were based on meeting human health risk-based goals assuming occasional use of the land and soil remediation to support frequent use of groundwater. This scenario is referred to as the baseline scenario. Based on the recent Tri-Party Agreement decision to use Washington State MTCA B regulations and EPA's proposed 15 mrem/yr radiation exposure criteria to establish soil remediation goals, an assessment was conducted to see how this change in cleanup goals affects the analysis of alternatives. The revised frequent use scenario (MTCA B/15 mrem/yr), discussed in the Sensitivity Analysis (Appendix D, Attachment 6), indicates that the revised frequent use scenario imposes the following two significant changes on the comparative analysis of alternatives.

1. The In Situ and Containment Alternatives are no longer appropriate for interim actions at the 100 Areas because these alternatives leave wastes at the site and thereby preclude several potential future uses. Interim actions, based on the recent Tri-Party decision, should be consistent with both frequent and occasional use of the land.

2. The revised frequent use scenario potentially requires less excavation than the baseline scenario. Therefore, the costs of the Removal/Disposal and Removal/Treatment/Disposal alternatives are reduced 32 and 30%, respectively, as compared to the baseline scenario. The baseline scenario costs are presented in Appendix B of the Process Document, and the costs and volumes for the revised frequent use scenario are presented in the Sensitivity Analysis (Appendix D).

With the elimination of the Containment and In Situ Treatment alternatives, the Removal/Disposal and Removal/Treatment/Disposal alternatives become the two principal remedial alternatives. The change from the baseline scenario to the revised frequent use scenario influences these two alternatives in similar ways. Therefore, there is very little effect on the key discriminators used for the comparative analysis. This means that the comparative analysis of these two alternatives under the baseline scenario changes only slightly as a result of the switch to the revised frequent use scenario. The next two subsections evaluate how the revised frequent use scenario changes the results of the original analysis of alternatives. The evaluation is based on information presented in Appendix D, the Process Document, and earlier sections of this FFS Appendix.

7.1 INFLUENCE OF THE REVISED FREQUENT USE CLEANUP GOALS ON THE 100-HR-1 FFS

The development of the remedial alternatives in the 100 Area Feasibility Study Phases 1 and 2 (DOE-RL 1993a) and the Process Document are not influenced by the change in cleanup goals, so the number and types of remedial alternatives remain the same. Likewise, the plug-in approach is still directly applicable for either the baseline or the revised frequent use scenarios.

The detailed analysis of the Removal/Disposal and Removal/Treatment/Disposal alternatives in the Process Document (Section 5.0) is influenced only slightly by the change in cleanup goals (less excavation is required by the revised frequent use scenario); therefore, there is no change in the assessment of these alternatives with regards to the CERCLA evaluation criteria and NEPA issues. The potential adverse effects of the Removal/Disposal and Removal/Treatment/Disposal alternatives on workers, future site uses, and the environment are also much the same under the revised frequent use scenario as they are under the baseline scenario. Therefore, the detailed analysis of alternatives in the Process Document and this 100-HR-1 FFS Appendix remain valid.

The comparative analysis in Section 6.0 of this FFS Appendix (see Tables 6-1 through 6-3) required changes because: (1) the In Situ and Containment alternatives drop out, and (2) the ranking based on costs must be recalculated. In most cases the recalculation of costs did not change the relative ranking of the alternatives. That is, the alternative with the highest total rank under the baseline scenario also generally received the highest rank under the revised frequent use scenario. The following subsection describes how the results of the comparative analysis change, in comparison to the results in Section 6.0 of the Process Document and this FFS Appendix, due to the change in the cleanup goals.

7.2 REVISED FREQUENT USE SCENARIO COMPARISON OF REMEDIAL ALTERNATIVES

7.2.1 116-H-7 Retention Basins

With the elimination of In Situ Vitrification as an alternative for the 116-H-7 retention basin, only Removal/Disposal and Removal/Treatment/Disposal are applicable for cleaning up the retention basins (compare Tables 6-1 and 7-1 in this FFS Appendix). The scoring and ranking of these two alternatives as presented in the Process Document and in this FFS Appendix are still valid, and even the cost scores do not change. The cost reductions of 32 and 30% for Removal/Disposal and Removal/Treatment/Disposal, respectively, did not effect the original cost scores in this case. Although the revised frequent use scenario requires less excavation than the baseline scenario, it does not change the relative advantages and disadvantages of the two alternatives and therefore, the comparative analysis remains essentially the same. The comparative analysis rankings for the 116-H-7 waste site, based on the revised frequent use scenario, are shown in Table 7-1 and the Removal/Disposal Alternative receives the highest rank.

7.2.2 116-H-1 Process Effluent Trench

There were three alternatives applicable to the Process Effluent Trench waste site group, as shown in Table 6-6 in the Process Document. However, as discussed in Section 3.0 of this FFS Appendix, the In Situ Vitrification Alternative is not applicable to the 116-H-1 site because the contaminated zone is thicker than 5.8 m (19 ft). Therefore, only two alternatives, the Removal/Disposal and Removal/Treatment/Disposal Alternatives are addressed in the site specific comparative analysis (Table 6-2 in this FFS Appendix). Under the revised frequent use scenario the quantitative rankings of these two alternatives do not change (compare Tables 6-2 and 7-2), and the results of the comparative analysis remain the same.

7.2.3 100-H Buried Pipelines

There were four remedial alternatives applicable to the Effluent (Buried) Pipelines waste site group, as shown in the Process Document (Table 6-10). Under the revised frequent use scenario the In Situ and Containment Alternatives are not applicable and therefore drop out of the analysis. Also, the Removal/Treatment/Disposal Alternative is not applicable to the 100-H Pipelines because the existing data indicate that the soil surrounding the pipeline is not contaminated, thus no treatment is necessary (see Section 6.0 in this FFS Appendix). Therefore, the Removal/Disposal Alternative is the only viable alternative for the 100-H Buried Pipelines.

7.2.4 116-H-4 Pluto Crib

The 116-H-4 Pluto Crib was removed and buried in the 118-H-5 burial ground in 1960. Therefore, as discussed in Section 6.0 of this FFS Appendix, no further action is warranted at this site.

7.2.5 Comparative Analysis Summary

At the 100-HR-1 Operable Unit, remedial alternatives were evaluated for cleaning up four interim remedial measure candidate sites. This evaluation indicates that one site, the 116-H-4 Pluto Crib, has already been remediated; and that only one remedial alternative is viable for the 100-H buried pipelines. At the remaining two sites, the 116-H-7 Retention Basins and the 116-H-1 Process Effluent Trench, there are two appropriate remedial alternatives, Removal/Disposal and Removal/Treatment/Disposal.

Table E7-1. New Remediation Concept for Quantitative Comparison of Evaluation Criteria for 116-H-7 Retention Basin.

CERCLA Evaluation Criteria	Remedial Alternatives					
	Removal/Disposal			Removal/Treatment/Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	7.00	7.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	4.00	2.00	0.50	5.00	2.50
Short-term Effectiveness	0.50	6.00	3.00	0.50	3.00	1.50
Implementability	1.00	9.00	9.00	1.00	5.00	5.00
Cost	1.00	10.00	10.00	1.00	8.00	8.00
Total Rank[b]			31.0			26.0

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

Table E7-2. New Remediation Concept for Quantitative Comparison of Evaluation Criteria for 116-H-1 Process Effluent Trench.

CERCLA Evaluation Criteria	Remedial Alternatives					
	Removal/Disposal			Removal/Treatment/ Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	7.00	7.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	3.00	1.50	0.50	5.00	2.50
Short-term Effectiveness	0.50	7.00	3.50	0.50	3.00	1.50
Implementability	1.00	7.00	7.00	1.00	5.00	5.00
Cost	1.00	10.00	10.00	1.00	8.00	8.00
Total Rank[b]			29.0			26.0

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

8.0 REFERENCES

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ATTACHMENT 1

WASTE SITE VOLUME ESTIMATES

Volume Estimate
100-HR-1 Operable Unit

OBJECTIVE:

Provide estimates of:

- The volume of contaminated materials within selected waste sites in the 100-HR-1 Operable Unit.
- The volume of materials that will need to be excavated to remove the contaminated materials.
- The areal extent of contamination

Estimates are provided for the following waste sites:

Site Number	Site Name	Page
116-H-1	107-H Liquid Waste Disposal Trench	EA1-7
116-H-4	105-H Pluto Crib	EA1-9
116-H-7	107-H Retention Basin	EA1-10
132-H-1	Reactor Exhaust Stack	EA1-12
132-H-2	117-H Filter Building	EA1-13
132-H-3	1608-H Wastewater Pumping Station	EA1-14
Pipelines	107-H Effluent Pipelines	EA1-15

Volume Estimate
100-HR-1 Operable Unit

METHOD:

The following steps are used to calculate volumes and areas for each waste site:

- Estimate the dimensions of each waste site.
- Estimate the location of the site.
- Estimate the extent of contamination present at each site.
- Estimate the extent of the excavation necessary to remove the contamination present.
- Calculate the volume of contamination present, the volume of material to be removed, and the areal extent of contamination.

Waste Site Dimensions -
Dimensions of the waste site are derived from all pertinent references. The reference used is noted in brackets [].

Waste Site Location -
Location of the waste site is derived from pertinent references, confirmed by field visit. The specific reference or method used to locate each site is discussed in a separate brief (see Reference 9). Coordinates for each waste site are converted to Washington State coordinates (see Reference 9). Resulting Washington State coordinates are presented herein.

Contaminated Volume Dimensions -
The extent of contamination present at the waste site is estimated from analytical data which exists for the site. The data used, assumptions made, and method for estimating extent is discussed in a separate brief (see Reference 10). Dimensions are summarized herein.

Excavated Volume Dimensions -
The extent of the excavation necessary to remove the contamination is based on a 1.5 H : 1.0 V excavation slope with the extent of contamination at depth serving as the bottom of the excavation.

Volume and Area Calculations -
The above information is used to construct a digital terrain model of each site within the computer program AutoCad. The computer program DCA is then used to calculate volumes and areas for the waste site.

ASSUMPTIONS:

The following assumptions were used to locate and/or provide dimensions for a waste site if no other data exists. See Reference 10 for assumptions concerning extent of contamination and Reference 9 for assumptions concerning location of the waste site.

Volume Estimate
100-HR-1 Operable Unit

ASSUMPTIONS (continued):

Burial Grounds -
- Burial ground dimensions are 6.10 m (20 ft) wide at the bottom, 6.10 m (20 ft) deep, and have 1.0 H : 1.0 V side slopes.
- Five feet of additional cover was provided.
- Burial grounds were filled completely.

Liquid Waste Sites -
- Trenches were built with 1.0 H : 1.0 V side slopes.
- Tops of cribs are (6 ft) below grade.

The following assumptions were used in calculating volumes and areas:
- No site interferences or overlaps are considered, volumes and areas are calculated for each waste site separately.

All depths are below grade unless noted.

REFERENCES:

1. DOE-RL, 1994, U.S. Department of Energy, Richland Operations Office, Hanford Site Waste Information Data System (WIDS), Richland, Washington.

2. 100-H Area Technical Baseline Report.

3. Hanford Site Drawings and Plans (P-1220, P-1221, M-1904-H, Sheet 4).

4. Site topographic maps, Drawings.

5. Historical photographs of the 100-H Area (#9621, Box 16273).

6. Dorian, J.J., and V.R. Richards, "Radiological Characterization of the Retired 100 Areas," UNI-946, May 1978, United Nuclear Industries, Richland, Washington.

7. DOE-RL, 1993, "Limited Field Investigations Report for the 100-HR-1 Operable Unit," DOE/RL-93-51, Draft A, U.S Department of Energy, Richland Operations Office, Richland, Washington.

8. Limited Field Investigation Report for 100-HR-3 OU.

9. IT Corporation, 1994, "100-HR-1 Waste Site Locations," IT Corporation Calculation Brief, Project Number 199806.409.

10. IT Corporation, 1994, "100-HR-1 Waste Site Contaminated Extent," IT Corporation Calculation Brief, Project Number 199806.409.

Volume Estimate
100-HR-1 Operable Unit

REFERENCES (continued):

11. IT Corporation, 1994, "100-HR-1 Pipe Locations", IT Corporation Calculation Brief, Project Number 199806.409.

Volume Estimate
100-HR-1 Operable Unit

SITE NUMBER: 116-H-1
SITE NAME: 107-H Liquid Waste Disposal Trench

WASTE SITE DIMENSIONS:

Length - 106 ft (32.3 m) along bottom, 193 ft (58.8 m) at surface [5]
Width - 37 ft (11.2 m) along bottom, 110 ft (33.5 m) at surface [5]
Depth - 15 ft (4.6 m) [5]
Slopes - Varies
Orientation - North-South [5]

Waste site consists of three lobes that were oriented from north to south [2]. Second lobe bottom is 405 ft x 120 ft (123.4 m x 36.6 m), third lobe bottom is 377 ft x 120 ft (114.9 m x 36.6 m) [5]. Second and third lobes appear to be approximately 5 ft deep [5]. Waste site has been backfilled to the surface [1]. The second and third lobes have not been documented as being used, therefore are not considered in the contaminated volume.

CONTAMINATED VOLUME DIMENSIONS:

Trench was filled to graded with liquids, side slopes and substrate are contaminated from the surface to groundwater [10].

Length - 193 ft (58.8 m) [10]
Width - 110 ft (33.5 m) [10]
Depth - 20 ft (6.1 m) [10]

EXCAVATED VOLUME DIMENSIONS:

Base of excavation is 193 ft (58.8 m) long by 110 ft (33.5 m) wide at a depth of 20 ft (6.1 m).

Excavation Slopes - 1.5 H : 1.0 V

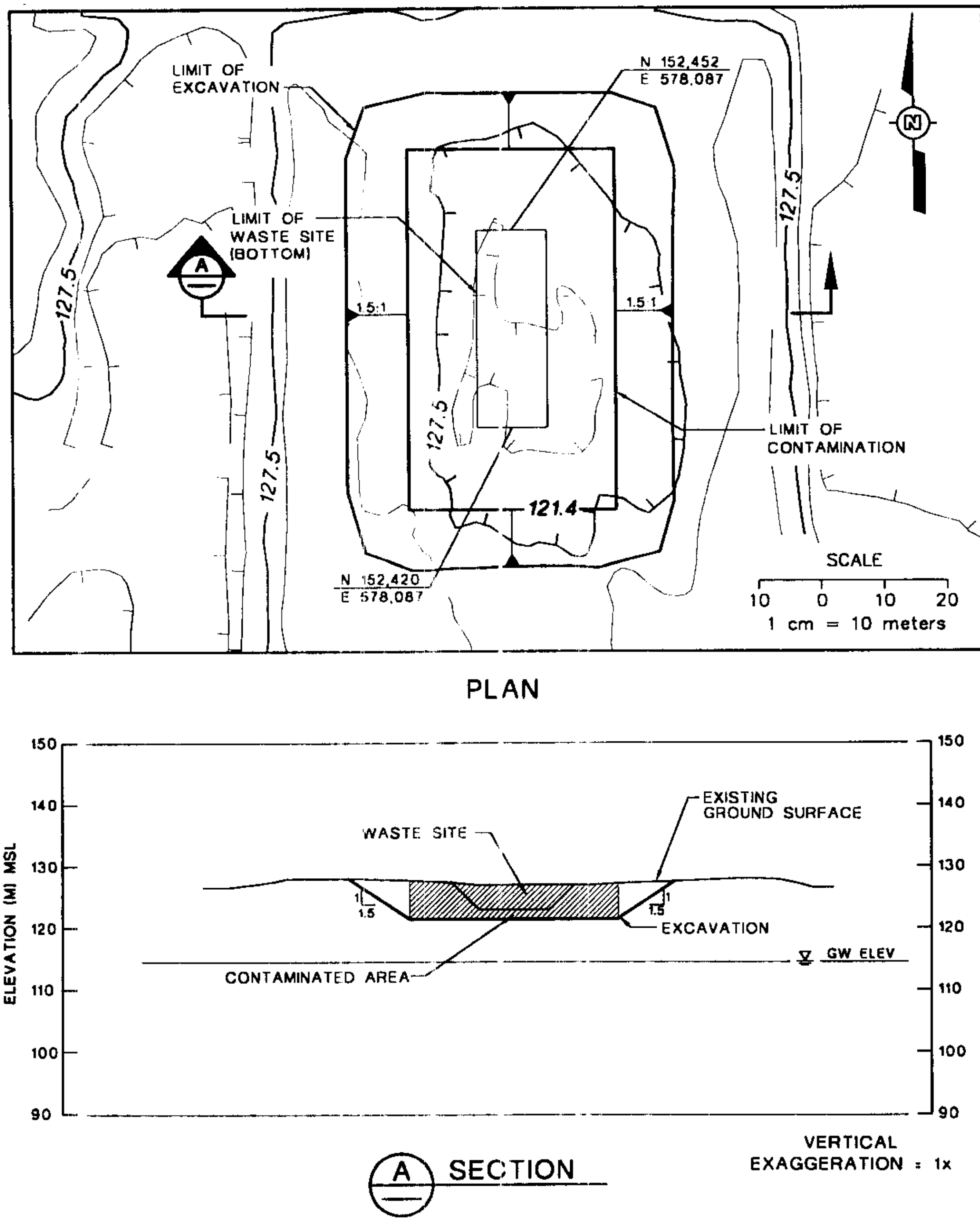
WASTE SITE LOCATION:

Northing:	152,452 [9]	Northing:	152,420 [9]
Easting:	578,087 [9]	Easting:	578,087 [9]
	Center of N edge		Center of S edge

ELEVATIONS:

Surface: 418 ft (127.5 m) [6]
Groundwater: 376 ft (114.5 m) [8]

Figure EA1-1. Interim Remedial Measures Site: 116-H-1.



EXTENT OF CONTAMINATION

SURFACE AREA = 1,970 sq. meters
VOLUME = 12,015 cu. meters

EXTENT OF EXCAVATION

SURFACE AREA = 3,951 sq. meters
VOLUME = 17,142 cu. meters

116H1

Volume Estimate
100-HR-1 Operable Unit

SITE NUMBER: 116-H-4
SITE NAME: 105-H Pluto Crib

WASTE SITE DIMENSIONS:

Length - 10 ft (3.1 m) [2]
Width - 10 ft (3.1 m) [2]
Depth - 10 ft (3.1 m) [2]
Slopes - Vertical
Orientation - North-South

Waste site was covered with 10 ft (3.1 m) of soil then exhumed and moved to 118-H-5 burial ground [1,2].

CONTAMINATED VOLUME DIMENSIONS:

Site was excavated and removed for construction of the 117-H filter building. It is assumed that during construction of the 117-H filter building all contaminants at depth were removed [10]. Assume no contaminated volume.

EXCAVATED VOLUME DIMENSIONS:

Not Applicable.

WASTE SITE LOCATION:

Northing: 152,479 [9]
Easting: 577,706 [9]

Reference Point: Center of crib.

ELEVATIONS:

Surface: 421 ft (128.5 m) [4]
Groundwater: 376 ft (114.7 m) [8]

Volume Estimate
100-HR-1 Operable Unit

SITE NUMBER: 116-H-7
SITE NAME: 107-H Retention Basin

WASTE SITE DIMENSIONS:

Length - 632 ft (192.6 m) [3,5]
Width - 276 ft (84.1 m) [3,5]
Depth - 20 ft (6.1 m) [2], bottom of basin @ elevation 396 ft (120.7 m) [4]
Slopes - Vertical
Orientation - Lengthwise N-S

Site was backfilled to 4 ft (1.2 m) above floor [1].

CONTAMINATED VOLUME DIMENSIONS:

Contamination extends 15 ft (4.5 m) in all directions [10].

Length - 662 ft (201.8 m) [10]
Width - 306 ft (93.3 m) [10]
Depth - 10 ft (3.0 m) [10] (below top of basin fill)

EXCAVATED VOLUME DIMENSIONS:

Bottom of excavation corresponds with contamination limits.

Excavation Slopes - 1.5 H : 1.0 V

WASTE SITE LOCATION:

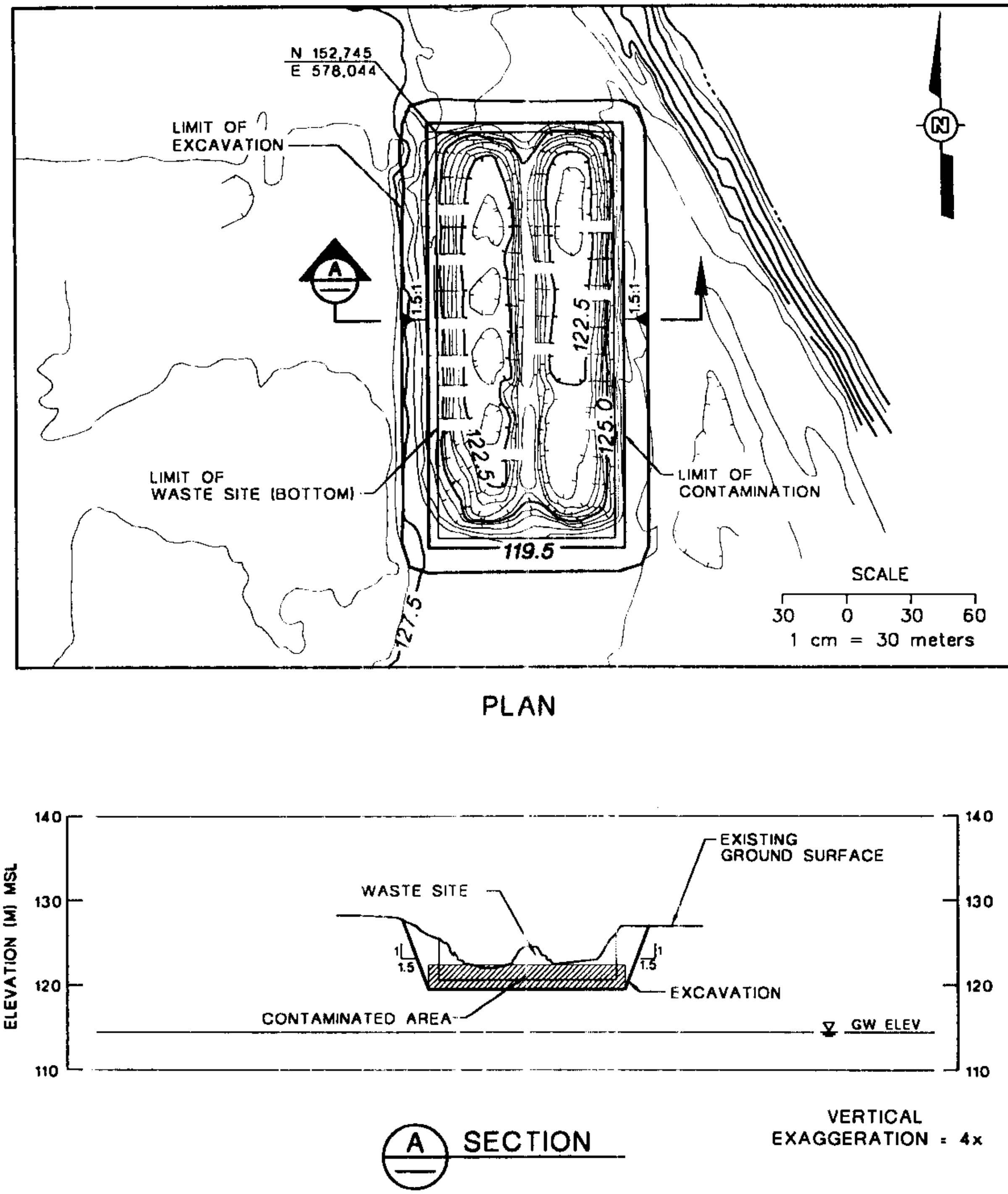
Northing: 152,745 [9]
Easting: 578,044 [9]

Reference Point: Northwest corner

ELEVATIONS:

Surface: 402 ft (122.5 m) [4]
Groundwater: 376 ft (114.6 m) [8]

Figure EA1-2. Interim Remedial Measures Site: 116-H-7.



EXTENT OF CONTAMINATION

SURFACE AREA = 18,828 sq. meters

VOLUME = 56,483 cu. meters

EXTENT OF EXCAVATION

SURFACE AREA = 25,900 sq. meters

VOLUME = 107,105 cu. meters

116H7

Volume Estimate
100-HR-1 Operable Unit

SITE NUMBER: 132-H-1
SITE NAME: Reactor Exhaust Stack

WASTE SITE DIMENSIONS:

Length - 200 ft (61.0 m) along bottom, 220 ft (67.1 m) at top of trench [2]
Width - 5 ft (1.5 m) along bottom, 25 ft (7.6 m) at top of trench [2]
Depth - 15 ft (4.6 m) [2]
Slopes - 1.0 H : 1.0 V
Orientation - East-West lengthwise

Stack was decontaminated, demolished, and buried between 117-H and 105-H buildings [2]. Site has been covered with 5 ft (1.5 m) of clean fill

CONTAMINATED VOLUME DIMENSIONS:

The site was decontaminated and decommissioned to ARCL methodology. Contamination is not expected at the site.

EXCAVATED VOLUME DIMENSIONS:

Not Applicable.

WASTE SITE LOCATION:

Northing: 152,504 [9]
Easting: 577,737 [9]

Reference Point: Center of east side of bottom of trench.

ELEVATIONS:

Surface: 418 ft (127.5 m) [4]
Groundwater: 376 ft (114.7 m) [8]

Volume Estimate
100-HR-1 Operable Unit

SITE NUMBER: 132-H-2
SITE NAME: 117-H Filter Building

WASTE SITE DIMENSIONS:

Length - 74 ft (22.6 m) [5]
Width - 41 ft (12.5 m) [5]
Depth - 29 ft (8.8 m) [1]
Slopes - Vertical
Orientation - East-West lengthwise

Site was originally 35 ft (10.7 m) tall with 32 ft (9.7 m) below grade [wids]. It was demolished In Situ with 3 ft (1 m) of cover.

CONTAMINATED VOLUME DIMENSIONS:

The site was decontaminated and decommissioned to ARCL methodology. Contamination is not expected at the site.

EXCAVATED VOLUME DIMENSIONS:

Not Applicable.

WASTE SITE LOCATION:

Northing: 152,495 [9]
Easting: 577,698 [9]

Reference Point: Northwest corner

ELEVATIONS:

Surface: 418 ft (127.5 m)
Groundwater: 376 ft (114.7 m)

Volume Estimate
100-HR-1 Operable Unit

SITE NUMBER: 132-H-3
SITE NAME: 1608-H Wastewater Pumping Station

WASTE SITE DIMENSIONS:

Length - 36 ft (11.0 m) [2]
Width - 34 ft (10.4 m) [2]
Depth - 3 ft (1.0 m) to 32 ft (9.7 m) [2]
Slopes - Vertical
Orientation - North-South lengthwise

Site was originally 44 ft (10.7 m) tall with 32 ft (9.7 m) below grade [2]. It was demolished In Situ with 3 ft (1 m) of cover.

CONTAMINATED VOLUME DIMENSIONS:

The site was decontaminated and decommissioned to ARCL methodology. Contamination is not expected at the site.

EXCAVATED VOLUME DIMENSIONS:

Not Applicable.

WASTE SITE LOCATION:

Northing: 152,480 [9]
Easting: 577,744 [9]

Reference Point: Northeast corner

ELEVATIONS:

Surface: 418 ft (127.5 m)
Groundwater: 376 ft (114.7 m)

Volume Estimate
100-HR-1 Operable Unit

SITE NUMBER:
SITE NAME: Effluent Pipelines (soil and sludge)

WASTE SITE DIMENSIONS:

Length - 2,961 ft (902.5 m) [3]
Width - 5 ft (1.5 m) diameter [3]
Depth - Varies [11]
Slopes - Varies
Orientation - Varies

Length - 1,068 ft (325.5 m) [3]
Width - 20" (0.51 m) [3]
Depth - Varies [11]
Slopes - Varies
Orientation - Varies

CONTAMINATED VOLUME DIMENSIONS:

Soil around pipe- No contamination along length of pipe.

Sludge inside pipe- All pipes have contaminated sludge along bottom. Volume of sludge is insignificant, the volume calculated will be that of pipe void.

EXCAVATED VOLUME DIMENSIONS:

Depends on depth of pipe. Base of excavation is 2 ft (0.6 m) on each side of the pipe and begins 3 inches below invert of pipe.

Excavation Slopes - 1.5 H : 1.0 V

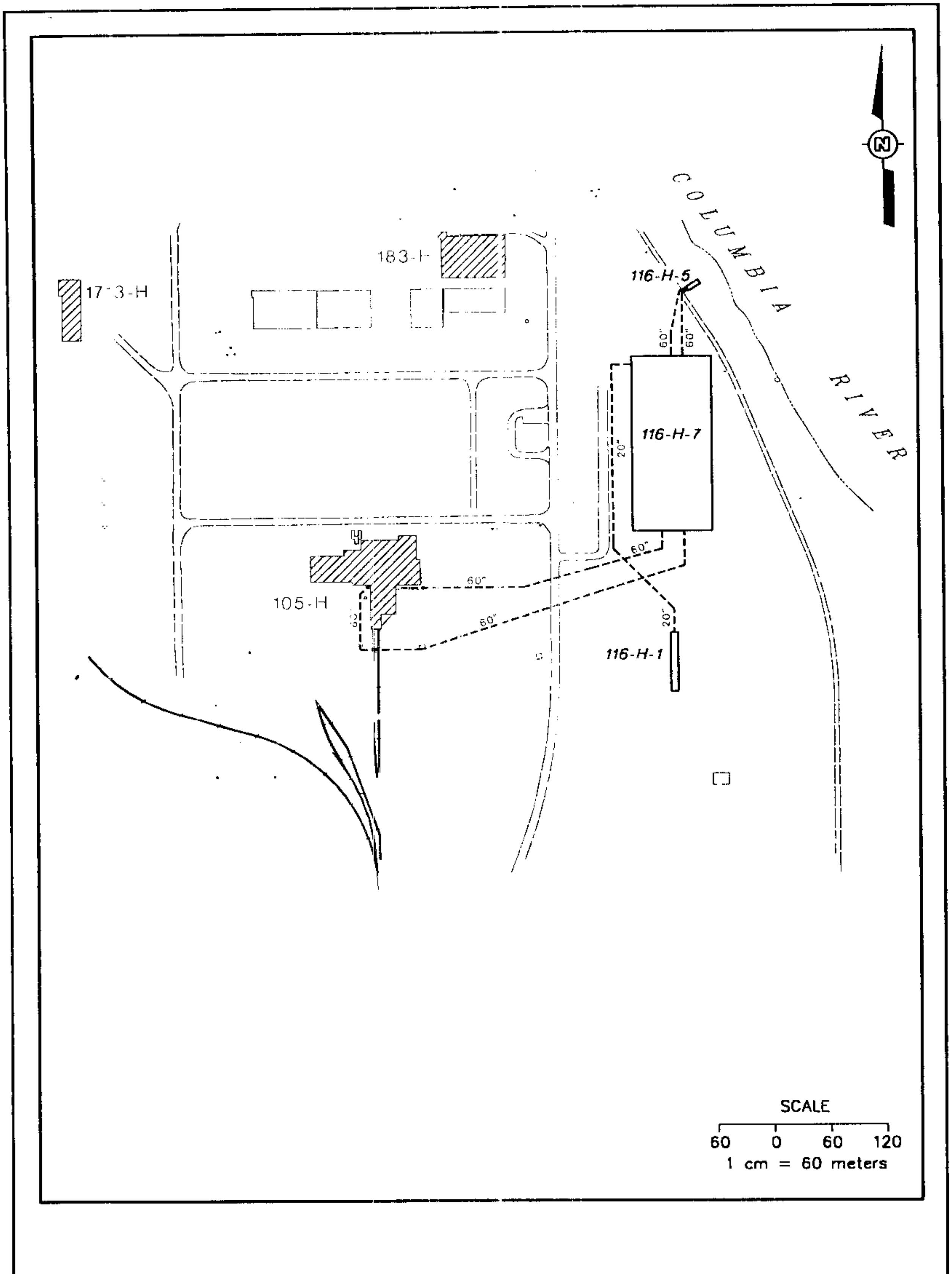
WASTE SITE LOCATION:

See figure.

ELEVATIONS:

See figure.

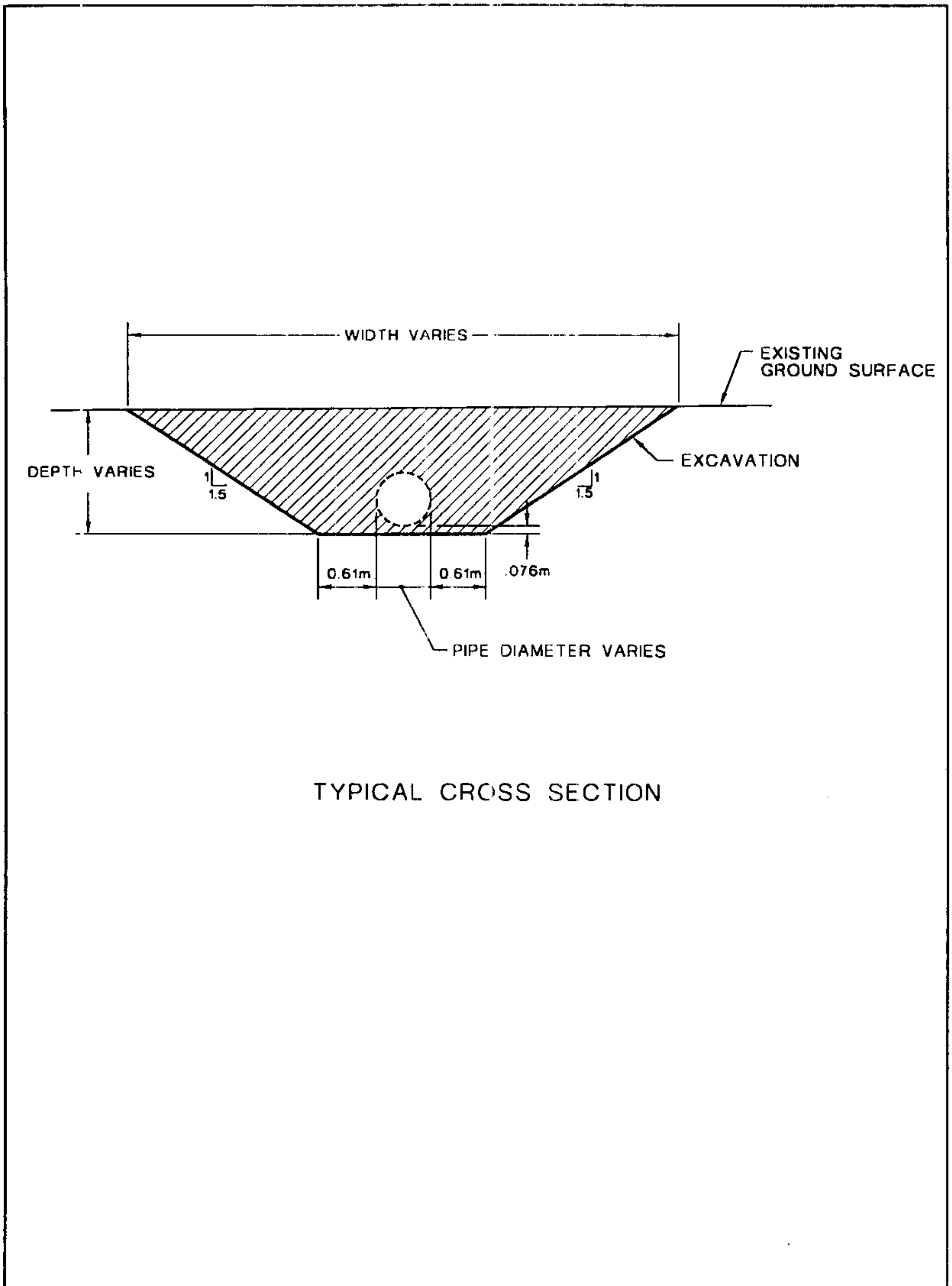
Figure EA1-3. Interim Remedial Measures Site: 100-H Buried Pipelines.



100HPLN

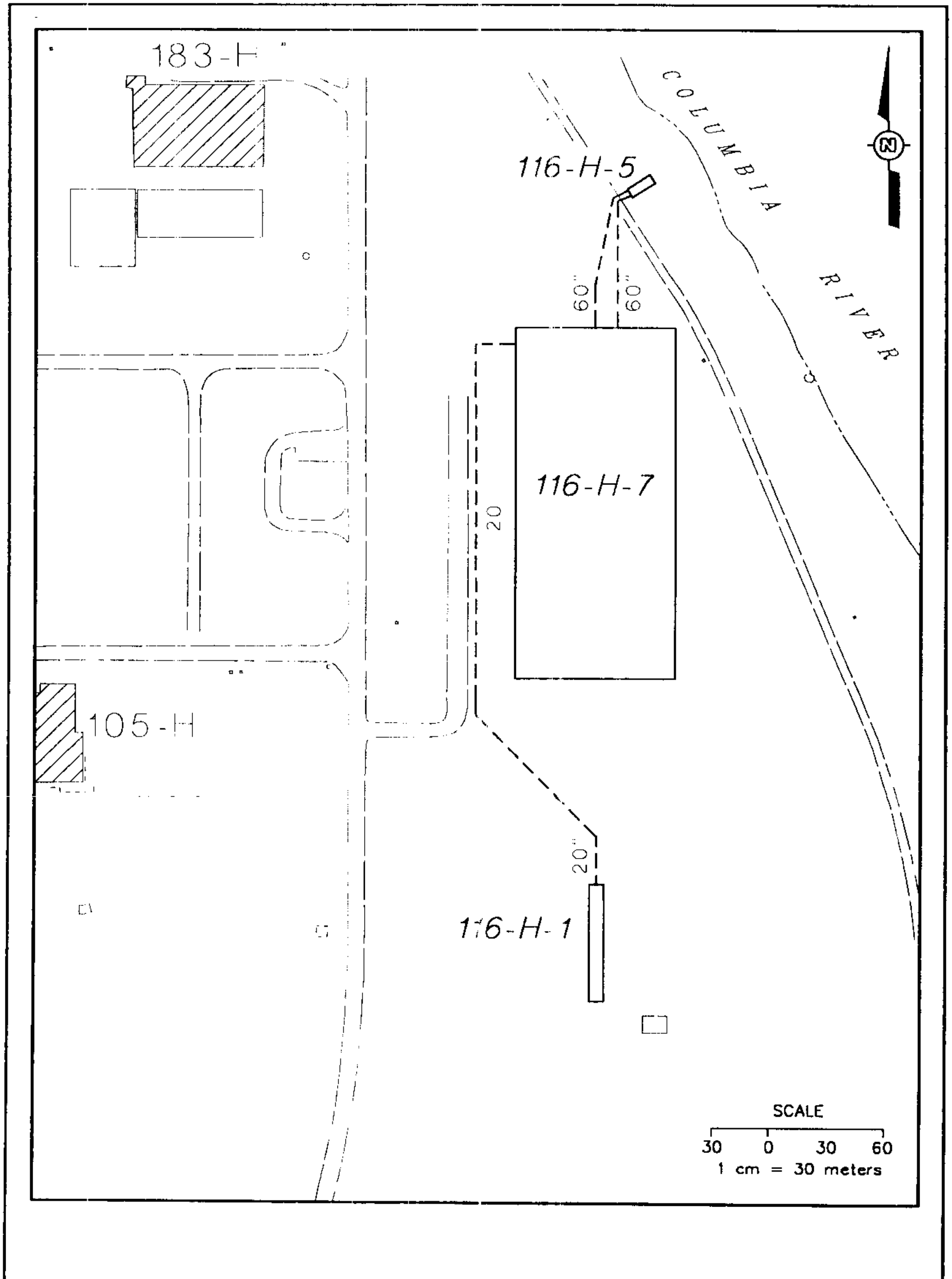
DRAFT

Figure EA1-4. Typical Pipeline Excavation Cross Section.



PEXSEC

Figure EA1-5. 100-H 20-in. Pipelines.



PLN20H

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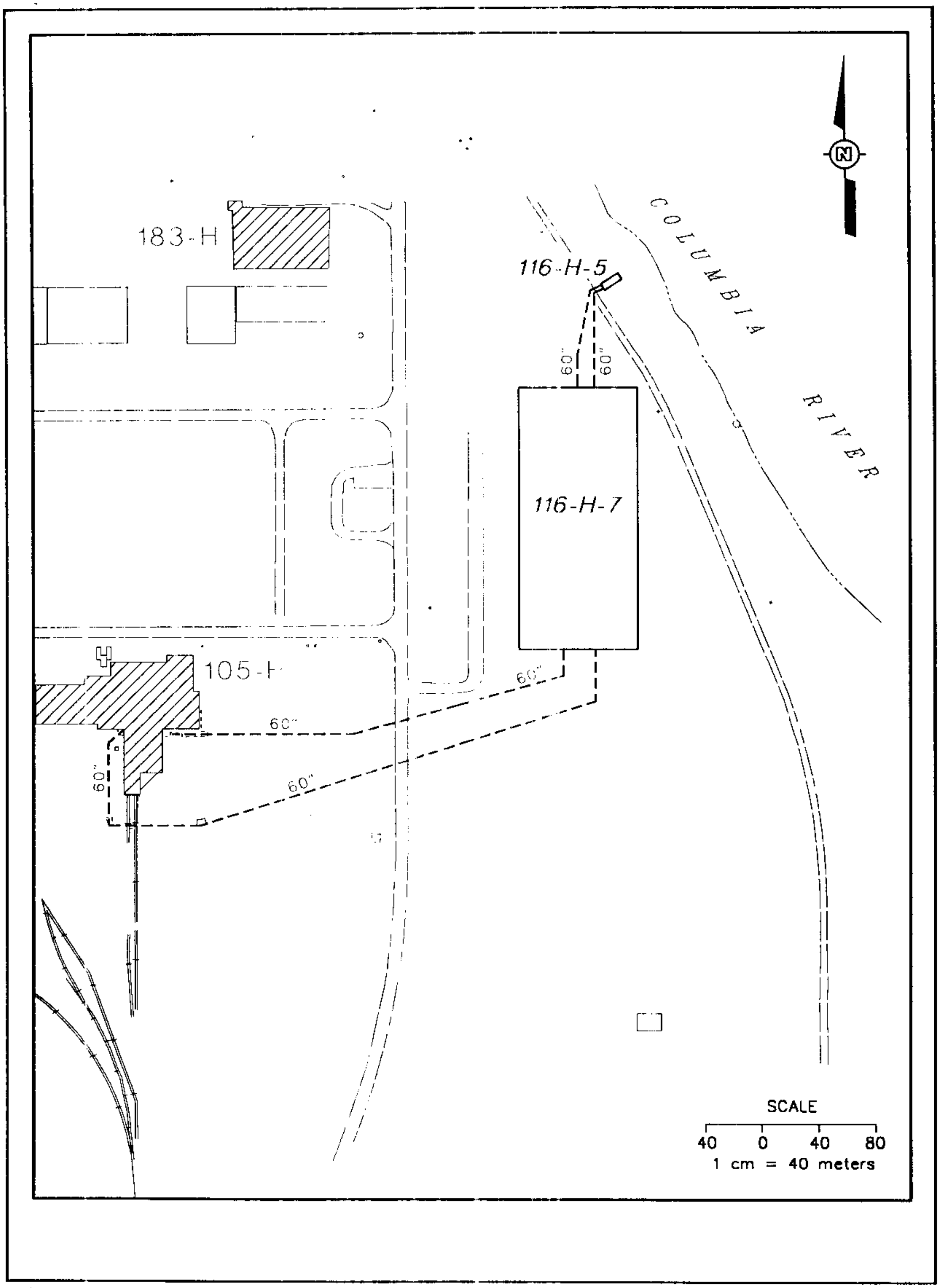
Figure EA1-6. 100-H 60-in. Pipelines.



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ATTACHMENT 2

100-HR-1 OPERABLE UNIT WASTE SITE COST ESTIMATES

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1.0 COST ESTIMATE SUMMARIES

This appendix describes the cost models developed to support the source operable unit focused feasibility study reports. This appendix also documents the cost estimates developed for each waste site using the cost models.

1.1 DESCRIPTION OF COST MODELS

A cost model defines the Remedial Alternative activities and provides a method in which to estimate the associated cost. Each cost model is developed using the MCACES[1] software package.

The focused feasibility study cost models are based on the Environmental Restoration cost models used to develop the fiscal year planning baselines. The Environmental Restoration cost models were modified for the source operable unit focused feasibility studies to include all costs associated with the Remedial Alternatives. Project Time and Cost, Inc., supported both the baseline and focused feasibility study cost estimating activities. The fourteen cost models associated with the source operable unit focused feasibility studies are presented in the *100 Area Source Operable Unit Focused Feasibility Study Cost Models* (WHC 1994).

All cost models were developed based on a common work breakdown structure. There are three main elements within the structure; Offsite Analytical Services (ANA), Fixed Price Contractor (SUB), and the Environmental Restoration Contractor (ERC). Each element is defined further by additional levels. Table EA2-1 describes each element and level of a cost model. The work breakdown structure discussion is applicable for each cost model.

1.2 WASTE SITE COST ESTIMATES

Cost estimates were developed for each waste site addressed by the focused feasibility study based on the applicable cost model. The present worth for each estimate is based on a 5% discount rate and a disposal fee of $70/cubic yard. Because of current uncertainty as to the actual disposal fee, a Sensitivity Analysis is based on $700/cubic yard and $7,000/cubic yard besides $70/cubic yard. A matrix of the waste site, cost estimate table, and cost comparison figure is presented on Table EA2-2.

[1]MCACES: Micro Computer Aided Cost Estimating System.
[2]The cost model terminology has not been updated to reflect the current change in the environmental restoration primary contractor.

Table EA2-1. 116-H-7 Retention Basin Disposal Cost Comparison[a].

Cost Element		SS-4	SS-8A	SS-10
ANA: Offsite Analytical Services				
ANA:02	Monitoring, Sampling & Analysis	$ 513,620	$ -	$ 964,090
SUB: Fixed Price Contractor				
SUB:01	Mobilization & Preparatory	89,650	75,170	81,697
SUB:02	Monitoring, Sampling & Analysis	194,690	119,320	479,882
SUB:08	Solids Collection & Containment	683,550	324,360	1,114,691
SUB:13	Physical Treatment	-	-	4,210,439
SUB:14	Thermal Treatment	-	-	-
SUB:15	Stabilization/Fixation	-	54,987,930	-
SUB:18	Disposal (Other than Commercial)	11,353,920	-	8,658,098
SUB:20	Site Restoration	1,719,930	1,131,090	1,768,917
SUB:21	Demobilization	18,610	17,440	17,087
ERC: Environmental Restoration Contractor				
ERC:02	Monitoring, Sampling & Analysis	390,960	4,926,780	917,727
ERC:08	Solids Collection & Containment	40,100	817,870	98,482
Subcontractor Materials Procurement Rate		140,600	566,550	163.308
Project Management/Construction Management		2,194,800	9,444,980	2,626,549
General & Administration/Common Support Pool		4,290,840	18,464,930	5,134,904
Contingency		7,787,260	30,897,990	9,707,272
Total		29,418,520	121,774,430	35,943,144
Capital		29,418,520	66,915,600	31,890,902
Annual Operations & Maintenance		0	6,772,695	4,052,242
Present Worth		28,022,466	97,972,216	34,242,818
SS-3/SW-3: Containment SS-4/SW-4: Removal/Disposal SS-8A/S-8B/SW7: In Situ Treatment SS-10/SW-9: Removal/Treatment/Disposal		1.0 10	3.496 3	1.22 8

[a]The cost model work breakdown structure is explained in Appendix B of the Process Document.

Table EA2-2. 116-H-1 Process Effluent Trench Disposal Cost Comparison.

Cost Element		SS-4	SS-10
ANA: Offsite Analytical Services			
ANA:02	Monitoring, Sampling & Analysis	$ 138,930	$ 235,760
SUB: Fixed Price Contractor			
SUB:01	Mobilization & Preparatory	61,290	67,940
SUB:02	Monitoring, Sampling & Analysis	58,950	89,580
SUB:08	Solids Collection & Containment	119,860	142,910
SUB:13	Physical Treatment	-	986,430
SUB:14	Thermal Treatment	-	-
SUB:15	Stabilization/Fixation	-	-
SUB:18	Disposal (Other than Commercial)	2,038,160	1,417,850
SUB:20	Site Restoration	411,940	358,950
SUB:21	Demobilization	15,050	15,240
ERC: Environmental Restoration Contractor			
ERC:02	Monitoring, Sampling & Analysis	134,830	233,540
ERC:08	Solids Collection & Containment	10,200	21,100
Subcontractor Materials Procurement Rate		197,480	224,760
Project Management/Construction Management		457,160	533,740
General & Administration/Common Support Pool		893,760	1,043,470
Contingency		1,542,790	1,987,370
Total		6,080,400	7,358,630
Capital		6,080,400	6,533,600
Annual Operations & Maintenance		0	825,030
Present Worth		5,793,890	7,018,407

SS-3/SW-3: Containment
SS-4/SW-4: Removal/Disposal
SS-8A/SS-8B/SW-7: In Situ Treatment
SS-10/SW-9: Removal/Treatment/Disposal

Table EA2-3. Effluent Buried Pipelines Disposal Cost Comparison.

Cost Element		SS-3	SS-4	SS-8B
ANA: Offsite Analytical Services				
ANA:02	Monitoring, Sampling & Analysis	$ -	$ 63,150	$ -
SUB: Fixed Price Contractor				
SUB:01	Mobilization & Preparatory	28,130	48,040	17,630
SUB:02	Monitoring, Sampling & Analysis	-	84,900	-
SUB:08	Solids Collection & Containment	4,032,330	293,990	428,890
SUB:13	Physical Treatment	-	-	-
SUB:14	Thermal Treatment	-	-	-
SUB:15	Stabilization/Fixation	-	-	-
SUB:18	Disposal (Other than Commercial)	-	10,070	-
SUB:20	Site Restoration	463,150	407,980	-
SUB:21	Demobilization	8,750	11,160	8,650
ERC: Environmental Restoration Contractor				
ERC:02	Monitoring, Sampling & Analysis	179,870	154,350	25,880
ERC:08	Solids Collection & Containment	4,220	21,100	1,410
Subcontractor Materials Procurement Rate		330,860	62,500	4,550
Project Management/Construction Management		757,100	164,110	73,050
General & Administration/Common Support Pool		1,480,130	320,840	142,820
Contingency		2,476,740	624,030	238,980
Total		9,761,290	2,266,210	941,870
Capital		9,761,290	2,266,210	941,870
Annual Operations & Maintenance		201,617	0	0
Present Worth		11,887,957	2,160,625	897,876
SS-3/SW-3: Containment SS-4/SW-4: Removal/Disposal SS-8A/SS-8B/SW-7: In Situ Treatment SS-10/SW-9: Removal/Treatment/Disposal		13.24 1	2.41 4	

APPENDIX F

100-BC-1 OPERABLE UNIT FOCUSED FEASIBILITY STUDY REPORT

ACRONYMS

ARAR	applicable or relevant and appropriate requirements
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
COPC	contaminants of potential concern
D&D	decontamination and decommissioning
EPA	U.S. Environmental Protection Agency
FFS	focused feasibility study
IRM	interim remedial measures
LFI	limited field investigation
PRG	preliminary remediation goals
QRA	qualitative risk assessment

CONTENTS

CONTENTS (continued)

FIGURES

CONTENTS (continued)

FIGURES (continued)

TABLES

CONTENTS (continued)

TABLES (continued)

1.0 INTRODUCTION

This 100-BC-1 Operable Unit FFS is prepared in support of the CERCLA RI/FS process for the 100 Areas. As discussed in Section 1.0 of the Process Document (Sections 1 through 6 of the main report plus Appendices A B, and C), the approach for the RI/FS activities for the 100 Areas has been defined in the Hanford Past Practice Strategy (DOE-RL 1991). The HPPS emphasizes timely integration of ongoing site characterization activities into the decision making process (the observational approach) and expedites the remedial action process by emphasizing the use of interim actions. This 100-BC-1 FFS, therefore, evaluates the remedial alternatives for interim action at fifteen high priority (candidates for interim remedial measures) waste sites within the 100-BC-1 Source Operable Unit, and provides the information needed for the timely selection of the most appropriate interim action at each of those waste sites. The high priority waste sites were originally defined in the 100-BC-1 Work Plan and further described in the Limited Field Investigation and Qualitative Risk Assessment (DOE-RL 1993d and WHC 1993).

As shown in Figure 1-2 of the Process Document, the FFS process for the 100 Areas is conducted in two stages; an evaluation of remedial alternatives for waste site groups (the Process Document) and an evaluation of the remedial alternatives for individual waste sites (the Operable Unit FFS). In this FFS, alternatives for cleaning up individual waste sites are chosen from the previously developed alternatives for waste site groups whenever the characteristics of the individual waste sites are sufficiently similar to the characteristics of the waste site groups. This approach, referred to as the "plug-in" approach, is used because there are many waste sites within the 100 Areas that are very similar to each other. This "plug-in" approach is further described in Sections 1.1 and 1.4 of the Process Document. The remedial action objectives and preliminary remediation goals that direct the analysis of alternatives in both the Process Document and the FFS are defined in Section 2.0 of the Process Document.

Alternatives were evaluated in the Process Document by establishing remedial goals based primarily on human health risk goals assuming an occasional-use of land surface and soil remediation to support frequent use of groundwater. This 100-BC-1 FFS Appendix also includes an evaluation of alternatives using these health-risk based goals via the "plug-in" approach. However, Ecology, EPA, and DOE recently decided to establish interim soil remedial goals based on the State of Washington's MTCA B regulations for organic and inorganic chemicals, and EPA's proposed standard of 15 mrem per year (above background) for radionuclides. Therefore, this 100-BC-1 FFS Appendix contains an additional comparative analysis section (Section 7.0) that describes how the results of the original alternative analyses in the Process Document and Sections 1 through 6 of this appendix may change as a result of using the new (MTCA B, 15 mrem) clean up goals. The results of the Sensitivity Analysis (Appendix D) was also used to evaluate the influence of revising clean-up goals because it evaluated the remedial alternatives using several different combinations of land and groundwater uses, including the baseline exposure scenario in the Process Document and the latest MTCA B and 15 mrem approach (the revised frequent use scenario). The conclusions reached in this 100-BC-1 FFS regarding interim remedial alternatives are presented in Section 7.0.

1.1 PURPOSE AND SCOPE

The scope of this document is limited to 100-BC-1 Operable Unit interim remedial measure candidate sites as determined in the Limited Field Investigation (DOE-RL 1993b). Impacted groundwater beneath the 100 B/C area will be addressed in the separate 100-BC-5 FFS. In addition, low priority waste sites and potentially impacted river sediments near the 100 Area are not considered candidates for interim remedial measures; they are being addressed under the remedial investigation/corrective measures study pathway of the *Hanford Past Practice Strategy* (DOE-RL 1991). The decision to limit the scope of the FFS is documented and justified in the work plan, the 100 Area Feasibility Study Phase I and II (DOE-RL 1993a), and the limited field investigation (DOE-RL 1993d).

This report presents the following:

- The 100-BC-1 Operable Unit individual waste site information (Section 2.0).
- The development of individual site profiles (Section 2.0)
- The identification of representative groups for individual waste sites and a comparison against the applicability criteria and identification of appropriate enhancements for the alternatives (Section 3.0).
- A discussion of the deviations and/or enhancements of an alternative and additional alternative development, as needed (Section 4.0).
- The detailed analyses for waste site which deviate from the representative group alternatives (Section 5.0).
- The comparative analysis for all waste sites using Process Document baseline scenario (Section 6.0).
- A discussion of the modifications to the baseline scenario due to the results of the Sensitivity Analysis (Section 7.0).
- A comparative analysis for all individual waste site using the revised scenario as developed in the Sensitivity Analysis, if applicable.

A summary of the FFS results for the 100-BC-1 interim remedial measure candidate waste sites is as follows:

- Thirteen of the individual waste sites plug directly into the waste site group alternatives without deviations.
- Waste site 116-B-5 is a special crib without a group profile; however, the site fits into the dummy decontamination crib/french drain group.

- Retention basin 116-C-5 is the only site requiring an alternative enhancement, thermal desorption.

- A waste site detailed analysis summary is presented on Table F5-1.

1.2 INCORPORATION OF NATIONAL ENVIRONMENTAL POLICY ACT VALUES

In accordance with DOE Order 5400.4 and Chapter 10 of the *Code of Federal Regulations* (CFR) Part 1021, the considerations (values) of the *National Environmental Policy Act of 1969* (NEPA) must be incorporated in the Comprehensive *Environmental Response, Compensation, and Liability Act* (CERCLA) process. The NEPA values are, therefore, incorporated in the Process Document (see sections 3.3 and 5.2).

Several NEPA values, such as a description of the affected environment (including meterology, hydrology, geology, ecological resources, and land use), applicable laws and guidelines, short-term and long-term impacts on human health and the environment, and cost are included in a typical CERCLA feasibility study. Other NEPA values not normally addressed in CERCLA feasibility study, such as socio-economic impacts, cultural resources, and transportation impacts, have been evaluated in the Process Document.

The NEPA impacts that are specific to the 100-BC-1 Operable Unit and a detailed analysis of alternatives are addressed in Section 5.0 of this document.

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2.0 WASTE SITE INFORMATION

2.1 OPERABLE UNIT BACKGROUND

The 100 Area at the Hanford Site is located in Benton County along the southern banks of the Columbia River, in the north central part of the site (Figure F2-1). The 100-BC Area is in the farthest upstream (west) reactor area along the Columbia River, and is about 6.4 km (4 mi) downstream of the Vernita Bridge. The 100-BC-1 Operable Unit comprises the northern half of the 100-BC Area and is located immediately adjacent to the Columbia River shoreline. The 100-BC-1 Operable Unit encompasses approximately 1.8 km^2 (0.7 mi^2) of the 100-B/C Area. It lies predominately within Section 11, the southern portion of Section 2, and the western portion of Section 12 of Township BN, Range 25E.

The 100-B/C Area contains two separate reactors, the B and C Reactors. The B Reactor is closer to the Columbia River and about 400 m (1,312 ft) north of the C Reactor. Many of the support facilities for both reactors, such as the cooling water retention basins, process effluent trenches, and sludge trenches are located closer to the river than either reactor (Figure F2-1). The 100-BC-1 Operable Unit is one of three operable units associated with the 100 B/C Area. The 100-BC-1 and 100-BC-2 Operable Units are source operable units, while the 100-BC-5 Operable Unit addresses groundwater. The 100-BC-1 Operable Unit includes the B Reactor (118-B-8); the retention basins, process effluent trenches, and sludge trenches for both reactors; and smaller burial grounds and liquid disposal facilities associated with the B Reactor. The 100-BC-2 Operable Unit includes the C Reactor 118-C-3, a portion of the effluent pipelines from the C Reactor, and small burial grounds and liquid disposal facilities associated with the C Reactor.

The groundwater below the source operable units in the 100-B/C Area is being addressed in the 100-BC-5 Operable Unit. The 100-BC-5 Operable Unit also is addressing groundwater adjacent to the operable unit; and surface water, sediments, and biota in the Columbia River near the 100-B/C Area.

The 100-B and 100-C Reactors were the first and fifth Hanford reactors built to manufacture plutonium during World War II. Fuel elements for the reactors were assembled in the 300 Area, and the plutonium-enriched fuel produced by the reactor was processed in the 200 Area. The 100-B Reactor operated from 1945 to 1965, when it was retired. The 100-C Reactor began operation in 1952 and was retired in 1969. After the reactors were retired, decontamination and decommissioning activities were initiated to minimize the potential spread of radioactive and other potential contaminants. This process is ongoing, although most of the structures in the 100-BC Area have been demolished.

Since the preparation of the *100 Area Feasibility Study Phases 1 and 2* (DOE-RL 1993a), additional data relevant to this FFS have been collected in both the 100 Area in general, and in the 100-BC-1 Operable Unit specifically. An LFI and QRA were performed for the 100-BC-1 Operable Unit (DOE-RL 1993b, WHC 1993). In addition, aggregate area studies were conducted to evaluate cultural and ecological resources within the 100 Area.

2.2 100 AREA AGGREGATE STUDIES

Hanford Site studies and studies within the 100 Area, such as the Hanford Site Background studies, provide integrated analyses of selected issues on a scale larger than the operable unit. The 100 Area groundwater operable unit work plans (e.g., DOE-RL 1992a, 1992b, and 1992c [the work plans for HR-3, FR-3, and KR-4]) provide information common to the 100 Area, covering topics such as river impacts, shoreline ecology, and cultural resources. The 100-B/C Area source and groundwater operable unit work plans provide detail on the physical setting within the 100-B/C Area, such as land form, geology, groundwater, surface water, meteorology, natural resources, and human resources (e.g., DOE-RL 1992d, 1992e, and 1993e). Studies that are applicable to the 100 Area source operable unit FFS are summarized in the following subsections.

2.2.1 Hanford Site Background Study

The characterization of the natural chemical composition of Hanford Site soils is presented in *Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes* (DOE-RL 1993d). The background values for inorganic constituents in soils, based on the above report, are discussed in Section 2.0 and Appendix A of the Process Document. Background values for radionuclides are currently under evaluation, but only a few are available at this time (see Appendix A of the Process Document).

2.2.2 Ecological Studies

Bird, mammal, and plant surveys in the 100 Area were conducted and reported by Sackschewsky and Landeen (1992). Conceptual food pathways and inventories of wildlife and plants at the Hanford Site, including threatened and endangered species, were presented by Weiss and Mitchell (1992). Cadwell (1994), described the aquatic species in the Hanford Reach of the Columbia River, the spatial distribution of vegetation types at Hanford, and surveys of species of concern, such as the shrub-steppe vegetation, threatened and endangered birds, and mule deer and elk populations. Cadwell (1994) concluded that intrusive-type remedial activities conducted inside the controlled-area fences should not have a significant impact on the wildlife. Landeen et al. (1993) stated that intrusive activities outside the controlled-area fences should have minimal impact on protected wildlife species if the recommendations contained in the three documents listed below are followed.

- *Bald Eagle Site Management Plan for the Hanford Site, South Central Washington* (Fitzner and Weiss 1994)
- *Biological Assessment for Threatened and Endangered Wildlife Species* (Fitzner, Weiss, and Stegen 1994)
- *Biological Assessment for State Candidate and Monitor Species* (Stegen 1992).

The plant community along the perimeter of the 100-B/C Area is comprised primarily of the alien species of tumblemustard, Russian thistle, and cheatgrass. Small stands of gray

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rabbitbrush, as well as a few scattered bunchgresses (mostly sand dropseed), are present both east and west of the B and C Reactors. Cheatgrass and Russian thistle dominate the eastern boundary of the 100-B/C Area. The central portion of the area is largely devoid of vegetation, with generally less than 5% cover (Stegen 1994). This area was physically disturbed by the original construction and operation of the reactors, and more recently by remedial work and weed control activities. The area extending northeast form the 100-B/C Area is primarily typified by relatively steep river banks dropping from the dry, cheatgrass-dominated uplands to the river shoreline, with a fairly narrow riparian zone. Along the river the vegetation is primarily reed canarygrass, Poa, sedges, and tickseed.

Bank erosion has created a steep embankment along the northeast shoreline of the 100-BC-1 Operable Unit, with a cobble shoreline and relatively sparse vegetation. However, the shoreline broadens upstream (west) and at the northwest corner of the 100-BC-1 Operable Unit to form an extensive riparian zone. This region upstream of the 100-B/C Area is dominated by a thick stand of willow, interspersed with patches of reed canarygrass, sedges, thickspike wheatgrass, and goldenrod. Much of the area is classified as a wetland, which is dome to at least three state sensitive species (the southern mudwort, false pimpernel, and shining flatsedge).

The habitats along the Columbia River support a wide variety of mammals, birds, reptiles, and insects. Habitats or vegetation that should be protected from damage during remedial work at the 100-B/C Area include the trees in the area, and riparian and wetland communities along the river.

The birds, mammals, reptiles, insects, and sensitive species found in the 100-B/C Area are the same as those common to the Hanford Site, and are discussed in Section 3.3 of the Process Document. The aquatic ecology of the 100 Area is also described in Section 3.3 of the Process Document. Islands in the Columbia River northwest of the 100 B/C Area, and the wetlands west (upstream), provide resting, nesting, and escape habitat for waterfowl, shorebirds, small mammals, and mule deer. Major fall Chinook salmon spawning areas occur between the 100-B/C and 100-K Areas, above Coyote Rapids.

Bald eagles, a federal and state listed threatened species, are seasonal residents at the Hanford Site, primarily along the river during November through March. There are numerous frequently used ground perches, primarily on the north shore of the Columbia River between the 100-B/C and 100-K Areas, and an infrequently used perch tree at the northeast corner of the 100-BC-1 Operable Unit. Remedial activities at the 100-B/C Area will have to be scheduled and conducted to avoid disturbing the eagles feeding and roosting activities. Guidance on issues dealing with bald eagles can be found in the Bald Eagle Site Management Plan (Fitzner and Weiss 1994). Peregrine falcons, a federally listed endangered species, have been observed only infrequently at the Hanford Site. They may use the area as a resting or feeding area during spring and fall migrations, but they do not nest at the Hanford Site.

Other species of concern that could potentially be influenced by remedial work in the 100-B/C Area include the Swainson's hawk, the ferruginous hawk, sepal yellowcress, and two aquatic molluscs (the Columbia pebblesnail and shortfaced lanx). The molluscs could be impacted if erosion causes an increase in sediment loads in the river or degraded water quality. Swainson's hawks, a state and federal candidate species, nest in areas several miles south and southwest of the 100-B/C Area. The closest nests are located about a mile west of the 100-B/C Area, on the north side of the Columbia River. These hawks will return to the same nesting sites year after year. Nesting ferruginous hawks are becoming more common at the Hanford Site (Fitzner and Newell 1989), but most nest far south and southeast of the 100-B/C Area. An inactive ferruginous hawk nest site exists about a mile south of the 100-B/C Area.

2.2.3 Cultural Resources

Various cultural resource-related investigations have been conducted in the 100-B/C Area over the last few decades. The investigations include archaeological reconnaissances, systematic surveys, test excavations, and interviews with Native Americans with historical ties to the area (Chatters, Gard, and Minthorn 1992; Relander 1986; Rice 1968 and 1980; Wright 1993). These investigations have resulted in the identification of several archaeological and ethnohistoric sites in and around the 100-BC-1 Operable Unit, which could range in age from 9,000 years ago to the mid-nineteenth century.

The 100-BC-1 Operable Unit is located in an area that has documented significant cultural resources. For example, surface surveys conducted in the area have revealed the presence of several prehistoric archaeological sites. One of these sites (45BN446), located adjacent to and probably within the 100-BC-1 Operable Unit, has been determined to be eligible for listing in the National Register of Historic Places. Diagnostic artifacts recovered from test excavations conducted in 1993 indicate that this site was occupied from as early as 2,000 years ago to 5,000 years ago. Other evidence of prehistoric activity in the area is documented by sites 45BN153 and 45BN430, both of which are located close to the 100 B/C Area; by site 45GR315 located across the river; and by numerous sites related to hunting and religious activities at Gable Butte, located just south of 100-B/C Area.

Given the known presence of archaeological sites in the 100-B/C Area, and the fact that buried archaeological deposits frequently cannot be detected from the surface, it is likely that other buried sites will be encountered during remediation activities at the 100-BC-1 Operable Unit. This is especially true for areas adjacent to the river because areas within 400 m (1,312 ft) of the Columbia River have high potential for cultural resources (Chatters 1989). Also, because discussions with Native American peoples with historical ties to 100-BC Area have yet to take place, other locations or features might be considered sacred or to be traditional cultural properties. Such discussions are planned for 1995.

The 100-B/C Area is also significant from a historical perspective, primarily because of the 100-B Reactor. This reactor is listed as a National Mechanical Engineering Landmark and is listed in the National Register of Historic Places (Cushing 1994). Another historic site (HT94-016), located adjacent to the 100-BC-1 Operable Unit, has yet to be evaluated for eligibility to the National Register. A third potential historic site (H3-17) was recorded just outside of the 100-BC-1 Operable Unit, but in 1994 this site was determined not to be eligible for the National Register.

To identify those waste sites that pose a potentially significant risk to cultural resources, cultural resource impact assessments are being conducted for each waste site in the 100-B/C Area. Assessment scores will be determined and presented in an action plan being prepared for the 100 BC Reactor Area by ERC cultural resource staff. These assessments will accelerate cultural resource reviews and clearances, which are required of all Hanford Site projects involving ground disturbing activities, as mandated in the Hanford Cultural Resource Management Plan (Chatters 1989).

Discussions among Department of Energy, ERC, and Tribal cultural resource staff should continue so that solutions to cultural resource concerns can be developed together. Potential impacts to cultural resources must be an integral component of the next phase of the remedial process, the development of the conceptual and preliminary remedial designs.

Preliminary results indicate that the following waste sites in the 100-BC-1 Operable Unit should be considered to have extremely high to moderately high cultural resource sensitivity:

Extremely High

- 126 B-1 184 Powerhouse Ash Pit
- 128 B-2 Burn Pit
- 128 B-3 Coal Ash and Demolition Waste Site
- 600-34 Baled Tumbleweed Site.

Moderately High

- 116-C-1 Liquid Waste Disposal Trench
- 126-B-3 Coal Pit
- 128-B-1 Coal Pit
- 1607-B-2 Septic Tank and Drain Field.

The remaining waste sites in BC-1 appear to have little potential for disturbing cultural resources. Activities planned for these waste sites should follow the normal Cultural Resource Review process.

Based on this existing information, the 100-BC-1 Operable Unit is considered to be extremely sensitive for cultural resources. Sensitive areas include not only those areas where cultural resources have been identified from previous surface investigations (the locations of which cannot be released in public documents), but also those areas where there is high potential for, but no surface indications of, subsurface cultural resources. Because of Tribal concerns, cleanup activities must incorporate actions to protect cultural resources.

2.2.4 Summary

The potential influence of remedial actions on the resources described in the preceding subsections are considered during the analysis of Remedial Alternatives conducted in Sections 5.0 and 6.0 of the Process Document and Sections 5.0, 6.0, and 7.0 of this 100-BC-1 FFS.

Other issues such as potential transportation and socioeconomic impacts, are also discussed in Sections 3.3 and 5.2 of the Process Document. The assessment of potential impacts in the Process Document are consistent with the potential impacts anticipated as a result of remediating the individual waste sites at the 100-BC-1 Operable Unit. Mitigation measures, as discussed in Section 5.2.2 of the Process Document, will be developed during the conceptual and preliminary design of the selected Remedial Alternative to avoid or minimize impacts on physical, biological, and cultural resources.

2.3 LIMITED FIELD INVESTIGATION

The LFI is an integral part of the RI/FS process and is based on Hanford Site-specific agreements discussed in the *Hanford Federal Facility Agreement and Consent Order* (Fourth Amendment) (Ecology et al. 1994), the *Hanford Site Risk Assessment Methodology* (DOE-RL 1995), the *RCRA Facility Investigation/Corrective Measures Study Work Plan for the 100-BC-1 Operable Unit* (DOE-RL 1992d), and the *Hanford Past-Practice Strategy (HPPS)* (DOE-RL 1991). The HPPS emphasizes initiating and completing waste-site cleanup through interim actions.

The primary purpose of the LFI at the 100-BC-1 Operable Unit (DOE-RL 1993b) was to collect sufficient data to recommend which of the 27 "high priority" sites identified in the 100-BC-2 workplan should remain as candidates for interim remedial measures (IRM). Sites that are not recommended for an IRM will be addressed later during the final remedy selection process for the entire 100 Area. The data gathered in the LFI are also used to evaluate Remedial Alternatives in this FFS.

A Qualitative Risk Assessment (QRA) was performed as part of the LFI, and determined the principal risk drivers at the 100-BC-1 Operable Unit. Another purpose of the 100-BC-1 QRA (WHC 1993) was to qualitatively evaluate human health and environmental exposure scenarios to help determine which waste sites within the 100-BC-1 Operable Unit were candidates for IRM. The QRA evaluated risks for a predefined set of human and environmental exposure scenarios, and is not intended to replace or be a substitute for a baseline risk assessment.

The QRA considered only two human health exposure scenarios (frequent- and occasional-use) with four pathways (soil ingestion, fugitive dust inhalation, inhalation of volatile organics from soil, and external radiation exposure), and an ecological exposure scenario based on ingestion of plants by the Great Basin pocket mouse.

For the human health risk assessment, frequent- and occasional-use exposure scenarios were evaluated to provide bounding estimates of risk consistent with the residential and recreational exposure scenarios presented in the *Hanford Site Risk Assessment Methodology* (DOE-RL 1995). Currently there are no such land uses in the

100-BC-1 Operable Unit. The estimated risks associated with carcinogenic contaminants at 100-BC-1 were grouped into four categories based on lifetime incremental cancer risk (ICR):

- high - ICR $>1 \times 10^{-2}$
- medium - ICR between 1×10^{-4} and 1×10^{-2}
- low - ICR between 1×10^{-6} and 1×10^{-4}
- very low - ICR $<1 \times 10^{-6}$.

A frequent-use scenario was evaluated in the year 2018 to ascertain potential future risks associated with each waste site after additional radionuclide decay. For the current occasional-use scenario, the effect of radiation shielding by the upper 2 m (6 ft) of soil on the external exposure risk at each waste site was also evaluated.

The ecological risk assessment evaluated contaminant uptake by the Great Basin pocket mouse. The mouse was used as an indicator receptor because it is common at the Hanford Site, its home range is comparable to the size of most waste sites, and it lives in close proximity to the contaminants in the soil. Ecological risks were defined by estimating the amount of contaminants received through ingestion of food, and then calculating an environmental hazard quotient. An environmental hazard quotient greater than one (unity) indicates that the contaminant poses a risk to individual mice.

The results of the LFI/QRA were used to select the sites where IRM should be evaluated. If an IRM is not justified, the site will be subject to further investigation and/or remediation under the site-wide RI/FS process. The LFI report for the 100-BC-1 Operable Unit described the field sampling program, identified the constituent concentrations at each of the sites, presented the data analysis, and discussed the risk assessment conclusions for the operable unit (DOE-RL 1993b).

Based on the LFI/QRA, waste sites at the 100-BC-1 Operable Unit were retained as IRM candidates if:

- The site posed a medium or high incremental cancer risk to humans under the occasional-use scenario

- The site contained noncarcinogenic contaminants that exceeded a human health hazard quotient of 1.0

- The site contained contaminants that posed a risk to the Great Basin pocket mouse (Environmental Hazard Quotient [EHQ] greater than 1.0)

- The conceptual exposure model could not be completed because of insufficient data

- The site had contaminants at levels that exceeded applicable or relevant and appropriate requirements (ARAR), Appendix C of the Process Document.

- The site had a probable current impact on groundwater, based on comparing onsite contaminant concentrations to groundwater protection criteria.

The LFI also assumed that solid waste burial grounds are IRM candidate sites regardless of the above criteria. The IRM candidacy review conducted during the LFI evaluation retained 18 waste sites and three burial grounds as IRM candidates (see Table F2-1).

Although the outfall structures at the 100-BC-1 Operable Unit were determined to be IRM candidate sites in the LFI, they have been recently designated for an expedited response action, in conjunction with the effluent pipelines at the operable unit. The *100 Area River Effluent Pipelines Expedited Response Action Proposal* (DOE-RL 1994) states that the 100 Area outfall structures will be addressed concurrently with the river pipelines. The 116-B-7, 132-B-6, and 132-C-2 outfall structures are therefore, not addressed further in this FFS. Finally, the 116-B-9 french drain and 166-B-10 dry well are characterized by incomplete conceptual models and are therefore not addressed further in this FFS.

The conclusions drawn from the LFI and QRA studies were used solely to determine IRM candidacy for high-priority waste sites and solid waste burial grounds within the 100-BC-1 Operable Unit. While this FFS report relies on the data presented in the LFI/QRA, the conclusions drawn in this FFS are based on the analyses of the Remedial Alternatives in Sections 5.0 and 6.0 of the Process Document, Sections 4.0 and 5.0 in the Sensitivity Analysis (Appendix D), and this FFS (Appendix F).

2.4 DEVELOPMENT OF WASTE-SITE PROFILES

To facilitate the implementation of the plug-in approach described in Section 1.1, waste-site profiles have been developed for each of the 16 IRM candidate sites within the 100-BC-1 Operable Unit. These 16 IRM candidate sites were selected from 21 high-priority waste sites (Table 2-1) within the 100-BC-1 Operable Unit during the LFI study (DOE-RL 1993b). The individual site profiles were developed using radiological data from Dorian and Richards (1978), field data obtained during the 1992 LFI, and information acquired during decontamination and decommissioning activities. When site-specific data were unavailable, data from an analogous site were assumed to be the most appropriate information for describing the conditions at the 100-BC-1 IRM site, and developing its waste-site profile.

2.4.1 Site Descriptions

The first step in developing the individual waste-site profiles was to prepare a basic site description of each IRM candidate site carried forward in this FFS (Table F2-2). This included listing the name of the site, describing its use during the operation of the B and C Reactors, describing its physical characteristics (the size and structural material), and determining which one of the waste site groups the individual waste site belonged in. The waste site groups are listed in Section 1.1 of this FFS and are described in Section 3.0 of the Process Document.

2.4.2 Refined Contaminants of Potential Concern

Another activity to develop the individual waste-site profiles, was determining what contaminants were present at each waste site that posed a risk to humans, biological receptors (plants and animals), and groundwater quality. These so called "refined COPC" are the risk drivers at the site and represent the contaminants that have to be remediated. The refined COPC were identified by starting with the list of COPC developed during the LFI and screening these contaminants against more stringent risk criteria, as described below.

The COPC (from the LFI) are defined as those contaminants that are known to occur within the operable unit or waste site, and were present at concentrations that exceeded natural background levels or conservative human risk criteria (ICR > 10^{-7} or HQ > 1.0). For example, if strontium-90 was present at soil concentrations above 193 pCi/g, it presented an incremental cancer risk greater than 10^{-7} and was considered a COPC. If strontium-90 concentrations were below this level the concentrations were considered to be below levels requiring further evaluation, and the contaminant was not a COPC.

The refined COPC for each IRM candidate site at the 100-BC-1 Operable Unit were identified by comparing the concentrations of the COPC to the preliminary remediation goals (PRG) developed in Section 2.0 and Appendix A of the Process Document. If the maximum COPC concentration at the waste site exceeded any of the PRGs, then that contaminant was considered a refined COPC. There can be one to several refined-COPC at each site, and the number and types of refined-COPC are used to help determine which Remedial Alternatives may be appropriate at the site. The derivation of the PRGs is described in Appendix A of the Process Document. The PRG represents the maximum concentration of a contaminant that would not exceed an acceptable human health or ecological risk level, or would not exceed the groundwater protection criteria. Table F2-3 presents the PRG that were developed in the Process Document. These preliminary remediation goals were never set at concentrations that were below natural background concentrations, to preclude trying to remediate naturally existing constituents in soils. Also, if the risk-based PRG was less that the laboratory required quantification/detection limit for that particular contaminant, then the quantification/detection limit was used as the PRG (for example, the PRG for carbon-14 was set at 50 pCi/g even though the groundwater protection PRG is 18 pCi/g, Table F2-3).

Two or more PRGs were determined for each COPC identified in the LFI, as shown in Table F2-3. All COPCs had a PRG that represented a concentration protective of groundwater, and almost all COPCs had a PRG based on human health risks assuming an occasional use exposure scenario. The PRGs for the carcinogenic radionuclides and chemicals represented the soil concentration that would pose an incremental cancer risk of one in a million. The human health PRGs for noncarcinogenic chemicals represented the concentration that would result in a hazard quotient of 0.1. For a given contaminant, the most stringent PRG was used, and the PRG were applied at two different depth strata depending on whether human and biological receptors would be exposed or protection of groundwater is the main factor. For example, for cobalt-60 the most stringent PRG is the one in a million incremental cancer risk level (soil concentration of 17.5 pCi/g). This PRG (17.5) is applicable at the 0 to 3 m (0 to 10 ft) depth strata because (1) humans are exposed to contaminants within the 0 to 1 m (0 to 3 ft) strata (assuming a recreational exposure scenario) and (2) the human health based PRG were used at depth strata where animals and plants 0 to 3 m (0 to 10 ft) are exposed because there is no ecological-based PRG available for cobalt-60 (i.e., the human health PRG is used as default values). It was assumed that there were no exposure pathways that would link contaminants below 3 m (10 ft) to humans, animals, or plants; therefore the groundwater protection PRG (1292 pCi/g is applied at the >3 m (10 ft) depth strata. The groundwater protection PRG is also applied to the 0 to 3 m (0 to 10 ft) depth strata if it is more stringent than the human risk PRGs.

To identify the refined COPC at each waste site, several assumptions and protocols were used to compare the COPC to the PRGs. These include the following:

- The soils within the waste site were divided into two depth strata, corresponding to the depth strata that the human and biological receptors and groundwater could be exposed to. This approach is discussed in detail in Section 2.0 and Appendix A of the Process Document.

- At each waste site, the maximum concentration of each contaminant (COPC) within each stratum was identified. The maximum concentration was taken from either the LFI data set or the Dorian and Richards (1978) data set.

- The historical data set (Dorian and Richards) was modified to account for radioactive decay between 1978 and 1992, so it was consistent with the LFI data set collected in 1992.

- If a sample was collected at the boundary between two strata (i.e., at 1 m [3 ft]) the data from that sample were applied to the shallower stratum (i.e., the 0 to 1 m [0 to 3 ft] strata).

- Historical or LFI data reported within a range (e.g., 2.6 to 4.8 m [8.5 to 16 ft]) were applied to two depth strata if appropriate (e.g., the 0 to 3 m [0 to 10 ft] and greater than 3 m [10 ft] ranges).

- The nickel-63 concentrations reported by Dorian and Richards (1978) may have been analyzed using a surrogate. Therefore, the concentrations reported in this FFS may not be an accurate representation of the actual concentration at the waste site. For the purpose of this FFS, the nickel-63 concentrations reported by Dorian and Richards were used as the best available estimate.

- Total uranium concentrations were reported by Dorian and Richards (1978) rather than specific isotopes. For the purpose of this FFS, the total concentrations were considered to be uranium-238 because uranium-238 was determined to be the major risk contributor of the uranium isotopes during the QRA.

The screening process that compares the COPC to PRG and identifies the refined COPC results in the identification of the contaminants that must be addressed by remedial action at the given IRM candidate site. Tables F2-4 through F2-11 present the PRG screening for the eight IRM candidate sites at the 100-BC-1 Operable Unit that have analytical data.

2.4.3 Waste-site Profiles

The waste-site profiles characterizing each individual waste site are presented in Table F2-12. Each profile includes the extent of contamination (how much soil may have to be excavated or what area may have to be capped), the depth of contamination, the media (i.e., soil) or material at the waste site, a list of refined COPCs at the waste site, and the maximum concentration observed for each refined-COPC. The waste-site profiles also state if the contaminant concentrations exceed the reduced infiltration concentration. The reduced infiltration concentration is the soil concentration that is considered protective of groundwater under the assumption that hydraulic infiltration is limited by a surface barrier over the wastes. The reduced infiltration concentrations are presented in Table F2-1; their derivation is discussed in Appendix A of the Process Document.

The waste-site profiles serve several purposes. First, they contain information needed to compare each waste site at 100-BC-1 to the Waste Site Groups developed in Section 3.0 of the Process Document. The profile information is also used to compare the site characteristics of each waste site with the applicability criteria developed in Section 4.0 of the Process Document, to help determine which Remedial Alternatives are or are not appropriate for that site. The area, depth, and volume of contamination is used to determine how much soil may have to be excavated, treated, capped, etc.; and this has a direct bearing on time and costs for remedial action. The information in the profiles is explained more in the following paragraphs, and the actual profiles are presented in Table F2-12.

- Extent of Contamination - This includes the volume, length, width, area, and thickness of the contaminated media. The volume estimates performed for each site are presented in Attachment 1 of this document. Volume, length, width, and area do not necessarily impact the determination of appropriate Remedial Alternatives; however, they are important considerations for developing costs and estimating the time required for remedial actions. Thickness of the contaminated lens impacts the implementability of In Situ actions such as vitrification, which has a limited vertical extent of influence.

- Contaminated Media/Material - Contaminated media and material located at the site are determined and described. Structural materials such as steel, concrete, and wooden timbers influence the applicability of Remedial Alternatives, as well as equipment needed for actions such as removal. The presence of solid wastes will influence material handling considerations and may require Remedial Alternatives that are different than alternatives for sites with just contaminated soil.

- Refined COPC/Maximum Concentrations - Refined COPC for a site are determined as discussed in Section 2.4.2. The associated maximum concentration for each refined COPC is the highest concentration detected at the site. Refined COPC may influence the applicability of Remedial Alternatives. For example, the presence of certain radioactive contaminants may allow natural decay to be considered in determining appropriate remedial actions The presence of organic contaminants may require that enhancements, such as thermal desorption, be added to a treatment system.

- Reduced Infiltration Concentration - The reduced infiltration concentration is a level that is considered protective of groundwater under a scenario where hydraulic infiltration is limited by the application of a surface barrier. The maximum refined COPC concentration detected is compared to the allowable reduced infiltration concentration. Exceedance of the reduced infiltration concentrations indicates that containment alternatives using a surface cap may not prevent contaminants from leaching into the groundwater below the site.

The following Section 3.0 on application of the plug-in approach describes the use of the site profiles during the feasibility study process.

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Figure F2-1. 100-BC Operable Unit Map.

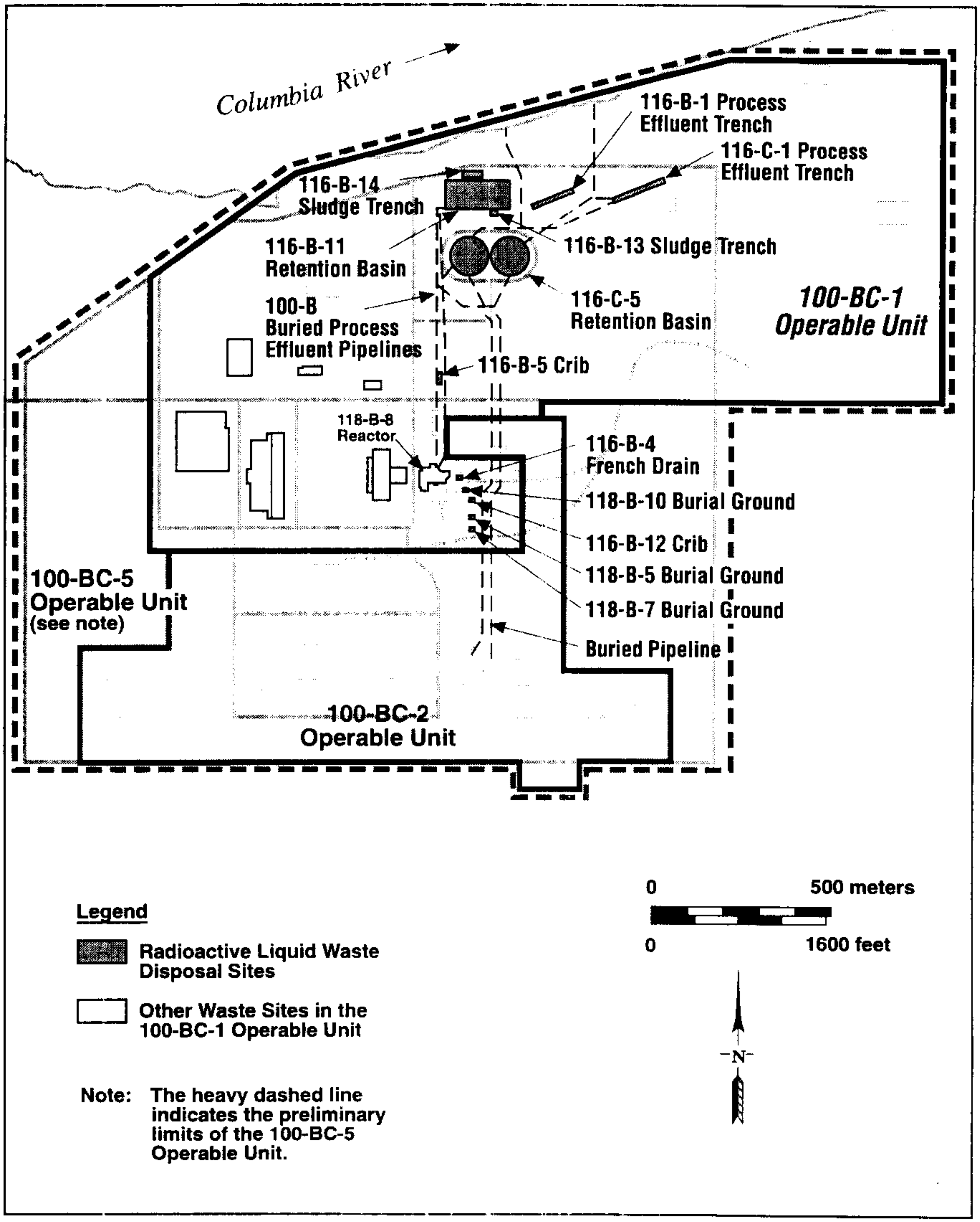

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Table F2-1. IRM Recommendations from the 100-BC-1 LFI.

Waste Site	Qualitative Risk Assessment		Conceptual Model	Exceeds ARAR	Probable Current Impact on Groundwater	Potential for Natural Attenuation by 2018	IRM Candidate yes/no
	Low-frequency scenario	EHQ > 1					
116-B-1 Process Effluent Trench	low	no	adequate	yes	yes	yes	yes
116-B-2 Trench	low	no	adequate	no	no	yes	no
116-B-3 Pluto Crib	low	no	adequate	no	no	yes	no
116-B-5 Crib	low	yes	adequate	no	no	yes	yes
116-C-5 Retention Basin	medium	yes	adequate	yes	yes	no	yes
116-C-1 Process Effluent Trench	medium	no	adequate	yes	yes	yes	yes
116-B-11 Retention Basin	high	yes	adequate	yes	yes	no	yes
Process Pipe (sludge)	high	yes	adequate	yes	yes	no	yes
Process Pipe (soil)	low	no	adequate	yes	yes	no	yes
116-B-13/14 Sludge Trench	medium	yes	adequate	yes	yes	no	yes
116-B-6A Crib	low	-	adequate	no	no	no	no
116-B-6B Crib	very low	no	adequate	no	no	no	no
116-B-4 French Drain	medium	-	adequate	no	no	yes	yes
116-B-9 French Drain	low	-	incomplete*	unknown*	no	unknown*	yes*
116-B-10 Dry Well	high	-	incomplete*	unknown*	no	unknown*	yes*
116-B-12 Seal Pit Crib	medium	-	adequate	no	yes	no	yes
132-B-4 and 132-B-5 (D&D Facility)	very low	yes	adequate	no	yes	no	yes
116-B-7, 116-B-6, and 132-C-2	medium	-	adequate	no	no	no	yes
128-B-3 Dump Site	low	-	adequate	no	no	no	no
126-B-2 Clear Well	low	-	adequate	no	no	no	no
118-B-5, 118-B-7, and 118-B-10 Burial grounds							yes

Source: 100-BC-1 LFI (DOE-RL 1993b)
EHQ = Environmental Hazard Quotient calculated by the qualitative ecological risk assessment
- = Not rated by the qualitative ecological risk assessment
* = Data needed concerning nature and vertical extent of contamination, waste site remains an IRM candidate until data are available, therefore not addressed in this FFS.
ARAR = Applicable or Relevant and Appropriate Requirements, specifically the *Washington State Model Toxics Control Act* Method B concentration values for soils

Table F2-2. 100-BC-1 Site Description. (Page 1 of 2)

Site #/Name/(Alias)	Use	Physical Dimensions	Data Source
116-B-11 Retention Basin (107-B Retention Basin)	Held cooling water effluent from B Reactor for cooling/decay before release to the Columbia River; large leaks of effluent to soil	F-101 143.3 x 70.1 x 1.5 m (469.2 x 229.6 x 4.9 ft) deep	Historical
116-C-5 Retention Basin (107-C Retention Basin)	Held cooling water effluent from B and C Reactors for cooling/decay before release to the Columbia River; large leaks of effluent to soil.	100.6 m (331 ft) diameter x 4.9 m (16.1 ft) deep (see F-97)	LFI, Historical
Pipelines	Transported reactor cooling water from reactors to retention basins, outfall structures, 116-B-1 and 116-C-1 trenches; leaked effluent to soil; contains contaminated sludge and scale.	Buried 6 m (19.6 ft) bls. ~6533 m (21,433.7 ft) total length; various diameters; various depths	Historical
116-B-1 Effluent Disposal Trench (107-B Liquid Waste Disposal Trench)	Received 60 million liters of high activity effluent produced by failed fuel elements; disposed effluent to the soil.	Unlined trench, backfilled. 114.3 x 9.1 x 4.6 m (375 x 49.9 x 15.1 ft) deep	LFI, Historical
116-C-1 Effluent Disposal Trench (107-C Liquid Waste Disposal Trench)	Received 700 million liters of high activity effluent produced by failed fuel elements; disposed effluent to the soil.	Unlined trench, backfilled. 152.4 x 15.2 x 7.6 m deep (500 x 50 x 25 ft)	Historical
116-B-13 Sludge Trench (107-B South Sludge Trench)	Received sludge from 116-B-11 retention basin; sludge disposed to soil then trench backfilled	Unlined trench, backfilled. 15.2 x 15.2 x 3 m (49.9 x 49.9 x 9.8 ft) deep	No Analytical Data
116-B-14 Sludge Trench (107-B North Sludge Trench	Received sludge from 116-B-11 retention basin; sludge disposal to soil then trench backfilled.	Unlined trench, backfilled. 36.6 x 3 x 3 m (120.1 x 9.8 x 9.8 ft) deep	No Analytical Data
116-B-4 French Drain (105 Dummy Decontamination French Drain)	Received 300,000 liters of effluent, e.g., contaminated spent acid from dummy decontamination facility; disposed effluent to soil.	Gravel filled pipe. 1.2 m (3.9 ft) diameter x 6.1 m (20 ft) deep	Historical
116-B-12 Seal Pit Crib (117-B Crib)	Received drainage from confinement seal system in 117-B building seal pits; disposed effluent to soil.	Timber reinforced excavation, filled with gravel, soil covered. 3 x 3 x 3 m (9.8 x 9.8 x 9.8 ft) deep.	No Analytical Data
116-B-5 Crib (108-B Crib)	Received 10 million liters of low-level effluent from contaminated maintenance shop and decontamination pad in 108-B building, including liquid tritium waste; disposed effluent to soil.	25.6 x 4.9 x 3.5 m (84 x 16.1 x 11.5 ft) deep	LFI, Historical
118-B-5 Burial Ground (Ball 3X)	Received highly contaminated reactor components removed from B Reactor.	Unlined L-shaped excavation. 2 m (6.5 ft) cover 22 x 22 x 8 x 14 x 14 x 8.2 x 6.1 m (72.2 x 72.2 x 26.25 x 46 x 46 x 26.9 x 20 ft) deep	Historical
118-B-7 Burial Ground (111-B Solid Waste Burial Site)	Miscellaneous solid waste (e.g., decontamination materials and associated equipment)	Unlined excavation. 2 m (6.5 ft) cover 7.3 x 7.3 x 2.4 m (23.95 x 23.95 x 7.87 ft) deep	Historical

Table F2-2. 100-BC-1 Site Description. (Page 2 of 2)

Site #/Name/(Alias)	Use	Physical Dimensions	Data Source
118-B-10 Burial Ground (115-B/C Caisson Site)	Received activated reactor components; buried in unlined excavation; backfilled with soil	Unlined excavation. 2 m (6.5 ft) cover 26.8 x 17.7 x 6.1 m (87.9 x 58 x 20 ft) deep	Historical
132-B-4 Filter Building (117-B Filter Building)	Contaminated building demolished in place; buried; covered with fill. (D&D Facility.)	Demolished reinforced concrete structure. Building: 18.0 x 11.9 x 8.2 m (59.1 x 39.05 x 26.9 ft) Tunnels: 58 m (190.3 ft) long	D&D
132-B-5 Gas Recirculation Building (115-B/C Gas Recirculation Facility)	Contaminated gas recirculation building demolished in place; buried; covered with fill (D&D Facility.)	Demolished reinforced concrete structure. 51.2 x 25.9 x 3.4 m (167.98 x 85 x 11.15 ft)	D&D

Source: 100-BC-1 LFI (DOE-RL 1993b)
LFI = limited field investigation
D&D = decontamination and decommissioning

Table F2-3. Potential Preliminary Remediation Goals.

	HUMAN-HSRAM (a,b)		PROTECTION of GROUNDWATER (a,c)	BACKGROUND (d,e)	CRQL/CRDL (f)	ZONE SPECIFIC PRG	
	TR = 1E-06	HQ = 0.1				1 (g) 0-10 ft.	2 (h) >10 ft.
RADIONUCLIDES (pCi/g)							
Am-241	76.9	N/A	31	N/C	1	31	31
C-14	44,200	N/A	18	N/C	50	50	50
Cs-134	3,460	N/A	517	N/C	0.1	517	517
Cs-137	5.68	N/A	775	1.8	0.1	6	775
Co-60	17.5	N/A	1,292	N/C	0.05	18	1,292
Eu-152	5.96	N/A	20,667	N/C	0.1	6	20,667
Eu-154	10.6	N/A	20,667	N/C	0.1	11	20,667
Eu-155	3,080	N/A	103,000	N/C	0.1	3,080	103,000
H-3	2,900,000	N/A	517	N/C	400	517	517
K-40	12.1	N/A	145	19.7	4	19.7	145
Na-22	545	N/A	207	N/C	4 (i)	207	207
Ni-63	184,000	N/A	46,500	N/C	30	46,500	46,500
Pu-238	87.9	N/A	5	N/C	1	5	5
Pu-239/240	72.8	N/A	4	0.035	1	4	4
Ra-226	1.1	N/A	0.03	0.98	0.1	1	1
Sr-90	1,930	N/A	129	0.36	1	129	129
Tc-99	28,900	N/A	26	N/C	15	26	26
Th-228	7,260	N/A	0.1	N/C	1 (j)	1	1
Th-232	162	N/A	0.01	N/C	1	1	1
U-233/234	165	N/A	5	1.1	1	5	5
U-235	23.6	N/A	6	N/C	1	6	6
U-238 (k)	58.4	N/A	6	1.04	1	6	6
INORGANICS (mg/kg)							
Antimony	N/A	167	0.002	N/C	6	6	6
Arsenic	16.2	125	0.013	9	1	9	9
Barium	N/A	29,200	258	175	20	258	258
Cadmium	1,360	417	0.775	N/C	0.5	0.8	0.775
Chromium VI	204	2,086	0.026	28	1	28	28
Lead	N/C	N/C	8	14.9	0.3	14.9	14.9
Manganese	N/A	2,086	13	583	1.5	583	583
Mercury	N/A	125	0.31	1.3	0.02	1.3	1.3
Zinc	N/A	100,000	775	79	2	775	775
ORGANICS (mg/kg)							
Aroclor 1260 (PCB)	4.34	N/A	1.37	<0.033	0.033	1	1
Benzo(a)pyrene	5	N/A	5.68	<0.330	0.330	5	6
Chrysene	N/A	N/A	0.01	<0.330	0.330	0.330	0.330
Pentachlorophenol	300	N/A	0.27	<0.8	0.8	0.8	0.8

TR=Target Risk; HQ= Hazard Quotient; N/A=Not Applicable; N/C=Not calculated
(a) Risk-based numbers based on a 1E-06 increased cancer risk for carcinogens and radionuclides and a noncancer hazard quotient of 0.1 for noncarcinogens.
(b) Occasional Use Scenario
(c) Based on Summer's Model (EPA 1989b)
(d) Status Report, Hanford Site Background: Evaluation of Existing Soil Radionuclide Data (Letter #008106)
(e) Hanford Site Background: Part 1, Soil Background for Nonradioacitve Analytes, DOE/RL-92-24, Rev. 2.
(f) Based on 100-BC-5 OU Work Plan QAPP (DOE-RL 1992)
(g) PRGs are established to be protective of groundwater, human and ecological receptors.
(h) PRGs are established to be protective of groundwater.
(i) Based on gross beta analysis
(j) Detection limit assumed to be same as Th-232
(k) Includes total U if no other data exist
(l) Value calculated exceeds 1,000,000 ppm therefore use 100,000 ppm as default

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Table F2-4. 116-B-11 Retention Basin Refined Contaminants of Potential Concern Based on Occasional Land Use Scenario and Protection of Groundwater.

116-B-11	Zone 1 (a)						Zone 2 (b)												Refined
	0 - 3 ft		3 - 6 ft		6 - 10 ft		10 - 15 ft		15 - 20 ft		20 - 25 ft		25 - 30 ft		30 - 35 ft		35 - 40 ft		COPC
	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Summary
RADIONUCLIDES (pCi/g)																			
Am-241		NO		NO		NO		NO		NO		NO		NO		NO		NO	
C-14	4.69E+00	NO	2.59E+02	YES		NO		NO		NO		NO		NO		NO		NO	YES
Cs-134	5.10E-01	NO	4.60E-01	NO	7.36E-03	NO	1.10E-01	NO	5.06E-02	NO	2.94E-03	NO	1.43E-03	NO		NO		NO	
Cs-137	3.74E+02	YES	8.30E+02	YES	2.91E+02	YES	2.70E+02	NO	1.45E+02	NO	4.98E+01	NO	3.04E+01	NO		NO	7.61E+00	NO	YES
Co-60	3.17E+03	YES	4.39E+03	YES	2.07E+03	YES	2.07E+02	NO	9.27E+01	NO	2.56E-01	NO	4.27E-01	NO		NO		NO	YES
Eu-152	1.02E+04	YES	2.83E+04	YES	1.02E+03	YES	9.72E+02	NO	2.87E+02	NO	1.90E+00	NO	4.86E+00	NO		NO		NO	YES
Eu-154	3.12E+03	YES	8.24E+03	YES	2.22E+02	YES	2.84E+02	NO	9.09E+01	NO	1.65E+00	NO	9.94E-01	NO		NO		NO	YES
Eu-155	9.42E+01	NO	5.03E+02	NO	5.89E+00	NO	5.14E+00	NO	7.70E+00	NO	1.71E+00	NO	1.39E-01	NO		NO	2.35E-02	NO	
H-3	[illegible]	NO	[illegible]	NO	1.70E+01	NO	6.89E-01	NO	7.70E+00	NO	1.54E+00	NO	2.27E+00	NO		NO		NO	
K-40		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Na-22		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Ni-63	5.10E+04	YES	3.76E+04	NO		NO		NO		NO		NO		NO		NO		NO	YES
Pu-238	4.14E+00	NO	7.66E+00	YES	5.11E-01	NO	2.82E-01	NO		NO		NO		NO		NO		NO	YES
Pu-239/240	1.70E+02	YES	3.40E+02	YES	1.80E+01	YES	1.10E+01	YES	7.60E+00	YES	6.75E-01	NO	3.40E-01	NO		NO		NO	YES
Ra-226		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Sr-90	2.10E+02	YES	5.43E+01	NO	5.43E+00	NO	3.33E+00	NO	4.82E+00	NO	1.97E+00	NO	6.65E-01	NO		NO	1.15E+00	NO	YES
Tc-99		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Th-228		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Th-232		NO		NO		NO		NO		NO		NO		NO		NO		NO	
U-233/234		NO		NO		NO		NO		NO		NO		NO		NO		NO	
U-235		NO		NO		NO		NO		NO		NO		NO		NO		NO	
U-238 (c)	[illegible]	[illegible]	[illegible]	YES	[illegible]	NO	3.90E-01	NO	4.20E-01	NO	2.20E-01	NO		NO		NO		NO	YES
INORGANICS (mg/kg)																			
Antimony		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Arsenic		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Barium		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Cadmium		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Chromium VI		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Lead		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Manganese		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Mercury		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Zinc		NO		NO		NO		NO		NO		NO		NO		NO		NO	
ORGANICS (mg/kg)																			
Aroclor 1260 (PCB)		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Benzo(a)pyrene		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Chrysene		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Pentachlorophenol		NO		NO		NO		NO		NO		NO		NO		NO		NO	

* Max concentration compared to the PRG (preliminary remediation goal). "Yes" if the value exceeds the PRG; "No" if the value is below the PRG.
The COPC (contaminants of potential concern) are refined based on the soil concentration and the PRG.
A blank in the "Max" means either no information was available or the constituent was not detected.

(a) PRGs are established to be protective of groundwater, human and ecological receptors.
(b) PRGs are established to be protective of groundwater.
Source:
[illegible] and V. R. Richards [illegible], Tables 2.7-1 - 2.7-9

Table F2-5. 116-C-5 Retention Basin Refined Contaminants of Potential Concern Based on Occasional Land Use Scenario and Protection Groundwater.

116-C-5	Zone 1 (a)						Zone 2 (b)												Refined
	0 - 3 ft		3 - 6 ft		6 - 10 ft		10 - 15 ft		15 - 20 ft		20 - 25 ft		25 - 30 ft		30 - 35 ft		35 - 40 ft		COPC
	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Summary
RADIONUCLIDES (pCi/g)																			
Am-241	3.40E+01	YES	1.30E-03	NO		NO		NO	4.00E-03	NO		NO		NO		NO		NO	YES
C-14	2.59E+02	YES		NO		NO		NO	4.10E-01	NO		NO		NO		NO		NO	YES
Cs-134	7.82E+00	NO	5.52E-01	NO	1.15E-03	NO	7.82E-04	NO	6.90E-04	NO	3.91E-03	NO		NO		NO		NO	
Cs-137	1.73E+03	YES	2.15E+03	YES	2.77E+01	YES	1.04E+02	NO	8.30E+01	NO	2.21E+01	NO		NO		NO		NO	YES
Co-60	1.95E+03	YES	3.05E+02	YES	6.22E+00	NO	3.17E+01	NO	5.00E+01	NO	5.86E+00	NO		NO		NO		NO	YES
Eu-152	5.75E+03	YES	1.37E+03	YES	5.75E+00	NO	1.64E+02	NO	1.72E+02	NO	2.61E+01	NO		NO		NO		NO	YES
Eu-154	6.53E+03	YES	7.10E+02	YES	1.16E+00	NO	4.54E+01	NO	4.83E+01	NO	8.24E+00	NO		NO		NO		NO	YES
Eu-155	5.35E+02	NO	7.38E-01	NO	1.07E-01	NO	1.71E+00	NO	3.32E+00	NO	9.20E-01	NO		NO		NO		NO	
H-3	2.47E-01	NO	1.78E+03	YES		NO	2.07E-01	NO		NO		NO		NO		NO		NO	YES
K-40		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Na-22		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Ni-63	4.56E+03	NO		NO		NO		NO		NO		NO		NO		NO		NO	
Pu-238	9.40E+00	YES		NO		NO		NO		NO		NO		NO		NO		NO	YES
Pu-239/240	2.30E+02	YES	7.90E+00	YES	2.40E-01	NO	1.80E+00	NO	1.90E+00	NO	2.90E-01	NO		NO		NO		NO	YES
Ra-226	8.40E-01	NO	6.80E-01	NO		NO		NO	1.02E+00	YES		NO		NO		NO		NO	YES
Sr-90	7.70E+02	YES	2.99E+02	YES	3.12E+00	NO	6.79E+00	NO	5.43E+00	NO	4.21E+00	NO		NO		NO		NO	YES
Tc-99		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Th-228		NO		NO		NO		NO	4.40E+00	YES		NO		NO		NO		NO	YES
Th-232		NO		NO		NO		NO		NO		NO		NO		NO		NO	
U-233/234	1.40E+00	NO		NO		NO	7.80E-01	NO	8.40E-01	NO		NO		NO		NO		NO	
U-235	8.00E-02	NO		NO		NO		NO	9.00E-03	NO		NO		NO		NO		NO	
U-238 (k)	3.00E+00	NO	9.90E-01	NO		NO		NO		NO		NO		NO		NO		NO	
INORGANICS (mg/kg)																			
Antimony		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Arsenic		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Barium		NO	2.60E+02	YES		NO		NO		NO		NO		NO		NO		NO	YES
Cadmium		NO		NO		NO		NO	8.40E-01	YES		NO		NO		NO		NO	YES
Chromium VI	6.09E+02	YES		NO		NO		NO		NO		NO		NO		NO		NO	YES
Lead	5.64E+02	YES		NO		NO		NO		NO		NO		NO		NO		NO	YES
Manganese		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Mercury	4.30E+00	YES		NO		NO		NO		NO		NO		NO		NO		NO	YES
Zinc	[illegible]	NO		NO		NO		NO		NO		NO		NO		NO		NO	
ORGANICS (mg/kg)																			
Aroclor [illegible]		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Benzo(a)pyrene		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Chrysene	1.00E-01	NO		NO		NO		NO		NO		NO		NO		NO		NO	
Pentachlorophenol	[illegible]	NO		NO		NO		NO		NO		NO		NO		NO		NO	

* Maximum concentrations are screened against the PRG (Potential Preliminary Remediation Goals, Table 2-3). "Yes" if the value exceeds the PRG. "No" if the value is below the PRG.
The COPCs (contaminants of potential concern) are refined based on the soil concentration and the PRG.
A blank under "Max" means either no information is available or the constituent was not detected.

(a) PRGs are established to be protective of groundwater, human and ecological receptors.
(b) PRGs are established to be protective of groundwater.
(c) Ra-226 is eliminated as a COPC because non-waste samples presented in Table 3-1 of the 100-BC-2 Operable Unit LFI report (DOE-RL 1994) show Radium-226 at a concentration of approximately 1 pCi/g (i.e., average +2 standard deviations).
Sources:
Dorian, J.J. and V.R. Richards. 1978. Tables 2,7-4, 5, 8, 13
DOE-RL 1993b. Tables 3-31, 32, 33, 36

116-C-5.XLS

DRAFT

Table F2-6. 116-B-1 Process Effluent Trench Refined Contaminants of Potential Concern Based on Occasional Land Use Scenario and Protection of Groundwater.

	Zone 1 (a)						Zone 2 (b)										Refined
116-B-1	0 - 3 ft		3 - 6 ft		6 - 10 ft		10 - 15 ft		15 - 20 ft		20 - 25 ft		25 - 30 ft		30 - 35 ft		COPC
	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Summary
RADIONUCLIDES (pCi/g)																	
Am-241		NO		NO		NO		NO	4.82E-01	NO	5.00E-02	NO	2.00E-03	NO		NO	
C-14		NO		NO		NO		NO	6.18E+00	NO	3.76E+00	NO	1.89E+00	NO		NO	
Cs-134		NO	3.13E-04	NO		NO		NO	4.53E-01	NO		NO		NO		NO	
Cs-137		NO	8.30E-02	NO		NO	1.80E-01	NO	4.39E+01	NO	1.04E+01	NO	1.39E+00	NO		NO	
Co-60		NO	2.68E-02	NO	1.34E-02	NO	3.42E-02	NO	4.76E+00	NO	3.89E-01	NO		NO		NO	
Eu-152		NO	4.42E-01	NO	3.45E-01	NO	7.07E-01	NO	1.22E+02	NO	1.76E+01	NO	4.11E+00	NO		NO	
Eu-154		NO		NO		NO	1.68E-01	NO	1.36E+01	NO	1.20E+00	NO		NO		NO	
Eu-155		NO	1.82E-02	NO	1.28E-02	NO	6.42E-03	NO	1.28E+00	NO		NO		NO		NO	
H-3		NO		NO		NO		NO	1.09E+00	NO		NO		NO		NO	
K-40		NO		NO		NO		NO		NO		NO		NO		NO	
Na-22		NO		NO		NO		NO		NO		NO		NO		NO	
Ni-63		NO		NO		NO		NO		NO		NO		NO		NO	
Pu-238		NO		NO		NO		NO	1.08E-01	NO		NO		NO		NO	
Pu-239/240		NO		NO		NO		NO	3.60E+00	NO	2.69E-01	NO		NO		NO	
Ra-226		NO		NO		NO		NO		NO		NO		NO		NO	
Sr-90		NO	8.83E-03	NO	4.75E-02	NO	2.58E-02	NO	1.32E+01	NO	5.08E+00	NO	1.54E+00	NO		NO	
Tc-99		NO		NO		NO		NO		NO		NO		NO		NO	
Th-228		NO		NO		NO		NO		NO		NO		NO		NO	
Th-232		NO		NO		NO		NO		NO		NO		NO		NO	
U-233/234		NO		NO		NO		NO		NO		NO		NO		NO	
U-235		NO		NO		NO		NO		NO		NO		NO		NO	
U-238 (k)		NO		NO		NO		NO	2.80E-01	NO		NO		NO		NO	
INORGANICS (mg/kg)																	
Antimony		NO		NO		NO		NO		NO		NO		NO		NO	
Arsenic		NO		NO		NO		NO		NO		NO		NO		NO	
Barium		NO		NO		NO		NO		NO		NO		NO		NO	
Cadmium		NO		NO		NO		NO		NO		NO		NO		NO	
Chromium VI		NO		NO		NO		NO	**3.30E+01**	**YES**		NO		NO		NO	YES
Lead		NO		NO		NO		NO		NO		NO		NO		NO	
Manganese		NO		NO		NO		NO	**8.39E+02**	**YES**		NO		NO		NO	YES
Mercury		NO		NO		NO		NO		NO		NO		NO		NO	
Zinc		NO		NO		NO		NO	1.28E+02	NO		NO		NO		NO	
ORGANICS (mg/kg)																	
Aroclor 1260 (PCB)		NO		NO		NO		NO		NO		NO		NO		NO	
Benzo(a)pyrene		NO		NO		NO		NO		NO		NO		NO		NO	
Chrysene		NO		NO		NO		NO		NO		NO		NO		NO	
Pentachlorophenol		NO		NO		NO		NO		NO		NO		NO		NO	

* Maximum concentrations are screened against the PRG (preliminary remediation goal). "Yes" if the value exceeds the PRG. "No" if the value is below the PRG.
The COPC (contaminants of potential concern) are refined based on the soil concentration and the PRG.
A blank under "Max" means either no information is available or the constituent was not detected.

(a) PRGs are established to be protective of groundwater, human and ecological receptors.
(b) PRGs are established to be protective of groundwater.
Sources:
Dorian, J.J. and V.R. Richards, 1978, Tables 2, 7-3
DOE-RL 1993b, Tables 3, 2, 3

116-B-1.XLS

DRAFT

Table F2-7. 116-C-1 Process Effluent Trench Refined Contaminants of Potential Concern Based on Occasional Land Use Scenario and Protection of Groundwater.

	Zone 1 (a)						Zone 2 (b)													Refined
116-C-1	0 - 3 ft		3 - 6 ft		6 - 10 ft		10 - 15 ft		15 - 20 ft		20 - 25 ft		25 - 30 ft		30 - 35 ft		35 - 40 ft		COPC
	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Summary
RADIONUCLIDES (pCi/g)																			
Am-241		NO		NO		NO		NO		NO		NO		NO		NO		NO	
C-14		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Cs-134		NO	2.67E-04	NO	8.28E-04	NO	9.66E-03	NO	3.13E-02	NO	1.10E-02	NO		NO		NO	2.07E-01	NO	
Cs-137		NO	2.42E-01	NO	1.18E+01	YES	3.60E+01	NO	5.54E+01	NO	3.32E+02	NO	1.45E+02	NO		NO	1.38E+01	NO	YES
Co-60		NO	3.66E-02	NO	2.68E+00	NO	6.34E+01	NO	2.20E+02	NO	5.73E+01	NO	4.76E+01	NO		NO	1.17E+00	NO	
Eu-152		NO	4.86E-01	NO	6.63E+00	YES	2.12E+02	NO	4.02E+02	NO	9.72E+01	NO	2.83E+02	NO	7.96E-02	NO	1.02E+01	NO	YES
Eu-154		NO	1.56E-01	NO	3.69E+00	NO	1.70E+02	NO	1.05E+02	NO	2.19E+01	NO	5.96E+01	NO		NO	3.41E+00	NO	
Eu-155		NO	3.00E-02	NO	1.82E-01	NO	2.25E+00	NO	6.53E+00	NO	1.03E+00	NO	3.00E+00	NO		NO	5.56E-01	NO	
H-3		NO	3.32E-01	NO	1.70E+00	NO	4.46E-01	NO	9.72E-01	NO	3.40E+00	NO	1.62E+01	NO		NO	8.51E+00	NO	
K-40		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Na-22		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Ni-63		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Pu-238		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Pu-239/240		NO		NO		NO	7.50E-01	NO	2.10E+00	NO	1.80E+00	NO	5.30E+00	YES		NO		NO	YES
Ra-226		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Sr-90		NO	2.65E-01	NO	2.78E-01	NO	5.36E-01	NO	5.23E-01	NO	6.65E-01	NO	5.70E+00	NO	2.51E-01	NO	1.40E-01	NO	
Tc-99		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Th-228		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Th-232		NO		NO		NO		NO		NO		NO		NO		NO		NO	
U-233/234		NO		NO		NO		NO		NO		NO		NO		NO		NO	
U-235		NO		NO		NO		NO		NO		NO		NO		NO		NO	
U-238 (k)		NO	7.50E-02	NO	3.10E-01	NO	2.20E-01	NO	3.20E-01	NO	2.50E-02	NO	1.60E-01	NO		NO	2.10E-01	NO	
INORGANICS (mg/kg)																			
Antimony		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Arsenic		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Barium		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Cadmium		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Chromium VI		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Lead		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Manganese		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Mercury		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Zinc		NO		NO		NO		NO		NO		NO		NO		NO		NO	
ORGANICS (mg/kg)																			
Aroclor 1260 (PCB)		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Benzo(a)pyrene		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Chrysene		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Pentachlorophenol		NO		NO		NO		NO		NO		NO		NO		NO		NO	

* Maximum concentrations are screened against the PRG (preliminary remediation goal): "Yes" if the value exceeds the PRG; "No" if the value is below the PRG.
The COPC (contaminants of potential concern) are refined based on the soil concentration and the PRG.
A blank under "Max" means either no information is available or the constituent was not detected.

(a) PRGs are established to be protective of groundwater, human and ecological receptors.
(b) PRGs are established to be protective of groundwater.
Sources:
Dorian, J.J. and V.R. Richards, 1978, Tables 2.7-6

116-4-XLS

Table F2-8. 116-B-5 Crib Refined Contaminants of Potential Concern Based on Occasional land Use Scenario and Protection of Groundwater.

116-B-5	Zone 1 (a)						Zone 2 (b)												Refined
	0 - 3 ft		3 - 6 ft		6 - 10 ft		10 - 15 ft		15 - 20 ft		20 - 25 ft		25 - 30 ft		30 - 35 ft		35 - 40 ft		COPC
	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Summary
RADIONUCLIDES (pCi/g)																			
Am-241		NO		NO	6.00E-03	NO	2.00E-03	NO	2.00E-03	NO		NO		NO		NO		NO	
C-14		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Cs-134		NO		NO	1.33E-04	NO		NO		NO		NO		NO		NO		NO	
Cs-137		NO		NO	3.11E-01	NO		NO		NO		NO		NO		NO	7.61E+00	NO	
Co-60		NO		NO	2.56E+00	NO	2.60E-01	NO	1.84E-01	NO		NO		NO		NO		NO	
Eu-152		NO		NO	1.15E+01	YES	1.53E+00	NO		NO		NO		NO		NO		NO	YES
Eu-154		NO		NO	2.53E+00	NO		NO		NO		NO		NO		NO		NO	
Eu-155		NO		NO	1.50E-02	NO		NO		NO		NO		NO		NO	2.35E-02	NO	
H-3		NO		NO	2.96E+04	YES		NO		NO	1.82E+02	NO		NO		NO		NO	YES
K-40		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Na-22		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Ni-63		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Pu-238		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Pu-239/240		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Ra-226		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Sr-90		NO		NO	1.09E-01	NO		NO	1.50E-01	NO		NO		NO		NO	1.15E+00	NO	
Tc-99		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Th-228		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Th-232		NO		NO		NO		NO		NO		NO		NO		NO		NO	
U-233/234		NO		NO		NO		NO		NO		NO		NO		NO		NO	
U-235		NO		NO		NO		NO		NO		NO		NO		NO		NO	
U-238 (k)		NO		NO		NO		NO		NO		NO		NO		NO		NO	
INORGANICS (mg/kg)																			
Antimony		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Arsenic		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Barium		NO		NO	9.02E+01	NO	4.84E+02	YES	7.86E+01	NO		NO		NO		NO		NO	YES
Cadmium		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Chromium VI		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Lead		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Manganese		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Mercury		NO		NO	1.40E+00	YES	1.10E+00	NO	2.90E+00	YES		NO		NO		NO		NO	YES
Zinc		NO		NO	6.84E+01	NO	6.94E+01	NO	1.25E+02	NO		NO		NO		NO		NO	
ORGANICS (mg/kg)																			
Aroclor 1260 (PCB)		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Benzo(a)pyrene		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Chrysene		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Pentachlorophenol		NO		NO		NO		NO		NO		NO		NO		NO		NO	

* Maximum concentrations are screened against the PRG (preliminary remediation goal). "Yes" if the value exceeds the PRG. "No" if the value is below the PRG.
The COPC (contaminants of potential concern) are refined based on the soil concentration and the PRG.
A blank under "Max" means either no information is available or the constituent was not detected.

(a) PRGs are established to be protective of groundwater, human and ecological receptors.
(b) PRGs are established to be protective of groundwater.
Sources
Dorian, J.J., and V.R. Richards, 1978, Tables 3.4-1
DOE-RL 1993b, Tables 3-24, 25

116-B-5.XLS

Table F2-9. 116-B-4 French Drain Refined Contaminants of Potential Concern Based on Occasional Land Use Scenario and Protection of Groundwater.

	Zone 1 (a)						Zone 2 (b)												Refined
116-B-4	0 - 3 ft		3 - 6 ft		6 - 10 ft		10 - 15 ft		15 - 20 ft		20 - 25 ft		25 - 30 ft		30 - 35 ft		35 - 40 ft		COPC
	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Summary
RADIONUCLIDES (pCi/g)																			
Am-241		NO		NO		NO		NO		NO		NO		NO		NO		NO	
C-14		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Cs-134		NO		NO	1.84E-04	NO		NO		NO		NO		NO		NO		NO	
Cs-137		NO		NO	**2.08E+02**	**YES**	6.71E+01	NO		NO		NO		NO		NO	7.61E+00	NO	YES
Co-60		NO		NO	**2.68E+02**	**YES**	6.34E+00	NO		NO		NO		NO		NO		NO	YES
Eu-152		NO		NO	**4.20E+02**	**YES**	3.05E+01	NO		NO		NO		NO		NO		NO	YES
Eu-154		NO		NO	**4.54E+01**	**YES**	4.83E+00	NO		NO		NO		NO		NO		NO	YES
Eu-155		NO		NO	6.53E+00	NO	2.14E-01	NO		NO		NO		NO		NO	2.35E-02	NO	
H-3		NO		NO	1.22E+02	NO		NO		NO		NO		NO		NO		NO	
K-40		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Na-22		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Ni-63		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Pu-238		NO		NO	2.91E-01	NO		NO		NO		NO		NO		NO		NO	
Pu-239/240		NO		NO	**8.60E+00**	**YES**	7.70E+00	YES		NO		NO		NO		NO		NO	YES
Ra-226		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Sr-90		NO		NO	3.73E+01	NO	2.24E+00	NO		NO		NO		NO		NO	1.15E+00	NO	
Tc-99		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Th-228		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Th-232		NO		NO		NO		NO		NO		NO		NO		NO		NO	
U-233/234		NO		NO		NO		NO		NO		NO		NO		NO		NO	
U-235		NO		NO		NO		NO		NO		NO		NO		NO		NO	
U-238 (k)		NO		NO	2.80E-01	NO		NO		NO		NO		NO		NO		NO	
INORGANICS (mg/kg)																			
Antimony		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Arsenic		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Barium		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Cadmium		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Chromium VI		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Lead		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Manganese		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Mercury		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Zinc		NO		NO		NO		NO		NO		NO		NO		NO		NO	
ORGANICS (mg/kg)																			
Aroclor 1260 (PCB)		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Benzo(a)pyrene		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Chrysene		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Pentachlorophenol		NO		NO		NO		NO		NO		NO		NO		NO		NO	

* Maximum concentrations are screened against the PRG (preliminary remediation goal). "Yes" if the value exceeds the PRG. "No" if the value is below the PRG.
The COPC (contaminants of potential concern) are refined based on the soil concentration and the PRG.
A blank under "Max" means either no information is available or the constituent was not detected.

(a) PRGs are established to be protective of groundwater, human and ecological receptors.
(b) PRGs are established to be protective of groundwater.
Sources:
Dorian, J.J. and V.R. Richards, 1978, Table 3.4-1
as 116-B-3, 105-B Pluto Crib

116-B-4.XLS

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Table F2-10. 100 B/C Pipeline Sludge Refined Contaminants of Potential Concern Based on Occasional Use Scenario.

	Zone 1 (a)						Zone 2 (b)												Refined
100 B/C PIPELINE SLUDGE	0 - 3 ft		3 - 6 ft		6 - 10 ft		10 - 15 ft		15 - 20 ft		20 - 25 ft		25 - 30 ft		30 - 35 ft		35 - 40 ft		COPC
	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Summary
RADIONUCLIDES (pCi/g)																			
Am-241		NO		NO		NO		NO		NO		NO		NO		NO		NO	
C-14	1.20E+01	NO		NO		NO		NO		NO		NO		NO		NO		NO	
Cs-134	1.66E+01	NO		NO		NO		NO		NO		NO		NO		NO		NO	
Cs-137	**1.11E+05**	**YES**		NO		NO		NO		NO		NO		NO		NO		NO	YES
Co-60	**2.81E+03**	**YES**		NO		NO		NO		NO		NO		NO		NO		NO	YES
Eu-152	**1.68E+04**	**YES**		NO		NO		NO		NO		NO		NO		NO		NO	YES
Eu-154	**3.41E+03**	**YES**		NO		NO		NO		NO		NO		NO		NO		NO	YES
Eu-155	**9.42E+03**	**YES**		NO		NO		NO		NO		NO		NO		NO		NO	YES
H-3	2.47E+00	NO		NO		NO		NO		NO		NO		NO		NO		NO	
K-40		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Na-22		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Ni-63	**6.18E+04**	**YES**		NO		NO		NO		NO		NO		NO		NO		NO	YES
Pu-238	**1.41E+02**	**YES**		NO		NO		NO		NO		NO		NO		NO		NO	YES
Pu-239/240	**2.80E+03**	**YES**		NO		NO		NO		NO		NO		NO		NO		NO	YES
Ra-226		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Sr-90	2.04E+03	YES		NO		NO		NO		NO		NO		NO		NO		NO	YES
Tc-99		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Th-228		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Th-232		NO		NO		NO		NO		NO		NO		NO		NO		NO	
U-233/234		NO		NO		NO		NO		NO		NO		NO		NO		NO	
U-235		NO		NO		NO		NO		NO		NO		NO		NO		NO	
U-238 (k)	2.30E-01	NO		NO		NO		NO		NO		NO		NO		NO		NO	
INORGANICS (mg/kg)																			
Antimony		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Arsenic		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Barium		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Cadmium		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Chromium VI		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Lead		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Manganese		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Mercury		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Zinc		NO		NO		NO		NO		NO		NO		NO		NO		NO	
ORGANICS (mg/kg)																			
Aroclor 1260 (PCB)		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Benzo(a)pyrene		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Chrysene		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Pentachlorophenol		NO		NO		NO		NO		NO		NO		NO		NO		NO	

* Maximum concentrations are screened against the PRG (preliminary remediation goal). "Yes" if the value exceeds the PRG. "No" if the value is below the PRG.
The COPC (contaminants of potential concern) are refined based on the soil concentration and the PRG.
A blank under "Max" means either no information is available or the constituent was not detected.

(a) PRGs are established to be protective of groundwater, human and ecological receptors
(b) PRGs are established to be protective of groundwater
Source:
Dorian, J.J., and V.R. Richards, 1978, Tables 2.7-24

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Table F2-11. 100 B/C Pipeline Soil Refined Contaminants of Potential Concern Based on Occasional Use Scenario.

100 B/C PIPELINE SOIL	Zone 1 (a) 0 - 3 ft		3 - 6 ft		6 - 10 ft		Zone 2 (b) 10 - 15 ft		15 - 20 ft		20 - 25 ft		25 - 30 ft		30 - 35 ft		35 - 40 ft		Refined COPC
	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Summary
RADIONUCLIDES (pCi/g)																			
C-14		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Cs-134		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Cs-137		NO		NO	3.96E-04	NO	4.32E-04	NO	6.44E-01	NO	9.20E-04	NO	2.44E-01	NO	6.44E-04	NO		NO	
Co-60		NO		NO	4.36E+00	NO	3.67E+00	NO	4.64E+03	YES	1.45E+02	NO	2.56E+03	YES	4.01E+01	NO		NO	YES
Eu-152		NO		NO	2.32E-01	NO	2.20E+00	NO	1.02E+02	NO	1.59E+01	NO	8.17E+01	NO	3.78E-01	NO		NO	
Eu-154		NO		NO	7.96E-01	NO	5.75E+00	NO		NO	3.36E+01	NO	1.11E+02	NO	1.99E+00	NO		NO	
Eu-155		NO		NO	1.85E-01	NO	8.80E-01	NO	1.02E+02	NO	5.68E+00	NO	2.75E+01	NO	4.54E-01	NO		NO	
H-3		NO		NO	8.88E-03	NO	2.57E-02	NO	3.21E+03	NO	2.89E-01	NO	1.61E+03	NO	8.67E-02	NO		NO	
K-40		NO		NO		NO		NO	4.86E+01	NO		NO	3.81E+01	NO		NO		NO	
Na-22		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Ni-63		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Pu-238		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Pu-239/240		NO		NO		NO		NO		NO		NO	3.61E-01	NO		NO		NO	
Ra-226		NO		NO	2.90E-01	NO	2.20E-01	NO	6.40E+00	YES	2.20E+00	NO	1.00E+01	YES	1.40E-01	NO		NO	YES
Sr-90		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Tc-99		NO		NO	1.87E-01	NO	1.56E+00	NO	8.15E+00	NO	1.36E+02	YES	6.79E+01	NO	8.83E+00	NO		NO	YES
Th-228		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Th-232		NO		NO		NO		NO		NO		NO		NO		NO		NO	
U-233/234		NO		NO		NO		NO		NO		NO		NO		NO		NO	
U-235		NO		NO		NO		NO		NO		NO		NO		NO		NO	
U-238 (k)		NO		NO		NO		NO		NO		NO		NO		NO		NO	
INORGANICS (mg/kg)		NO		NO		NO		NO	4.20E-01	NO	5.20E-01	NO		NO		NO		NO	
Antimony																			
Arsenic		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Barium		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Cadmium		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Chromium VI		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Lead		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Manganese		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Mercury		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Zinc		NO		NO		NO		NO		NO		NO		NO		NO		NO	
ORGANICS (mg/kg)		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Aroclor 1260 (PCB)																			
Benzo(a)pyrene		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Chrysene		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Pentachlorophenol		NO		NO		NO		NO		NO		NO		NO		NO		NO	
#VALUE!		NO		NO		NO		NO		NO		NO		NO		NO		NO	

* Maximum concentrations are screened against the PRG (preliminary remediation goal). "Yes" if the value exceeds the PRG. "No" if the value is below the PRG.
The COPC (contaminants of potential concern) are refined based on the soil concentration and the PRG.
A blank under "Max" means either no information is available or the constituent was not detected.

(a) PRGs are established to be protective of groundwater, human and ecological receptors.
(b) PRGs are established to be protective of groundwater.
Sources:
Dorian, J.J., and V.R. Richards, 1978, Tables 2.7-19, 20.

PIPESOIL.XLS

Table F2-12. Allowable Soil Concentration - Reduced Infiltration Scenario.

Analyte	Soil Concentration
RADIONUCLIDES	**pCi/g**
^{241}Am	$5.01(10^{3})$
^{14}C	$2.92(10^{3})$
^{134}Cs	$8.35(10^{4})$
^{137}Cs	$1.25(10^{5})$
^{60}Co	$2.09(10^{5})$
^{152}Eu	$3.34(10^{6})$
^{154}Eu	$3.34(10^{6})$
^{155}Eu	$1.67(10^{7})$
^{3}H	$8.35(10^{4})$
^{40}K	$2.34(10^{4})$
^{22}Na	$3.34(10^{4})$
^{63}Ni	$7.52(10^{6})$
^{238}Pu	$8.35(10^{2})$
$^{239/240}Pu$	$6.27(10^{2})$
^{226}Ra	$4.00(10^{0})$
^{90}Sr	$2.09(10^{4})$
^{99}Tc	$4.18(10^{3})$
^{228}Th	$1.67(10^{1})$
^{232}Th	$2.09(10^{0})$
$^{233/234}U$	$8.35(10^{2})$
^{235}U	$1.00(10^{3})$
^{238}U	$1.00(10^{3})$
INORGANICS	**mg/kg**
Antimony	$2.51(10^{-1})$
Arsenic	$2.09(10^{0})$
Barium	$4.18(10^{4})$
Cadmium	$1.25(10^{2})$
Chromium (VI)	$4.18(10^{0})$
Lead	$1.25(10^{3})$
Manganese	$2.09(10^{3})$
Mercury	$5.01(10^{1})$
Zinc	$1.25(10^{5})$
ORGANICS	**mg/kg**
Aroclor 1260	$2.21(10^{2})$
Benzo(a)pyrene	$9.19(10^{2})$
Chrysene	$2.00(10^{0})$
Pentachlorophenol	$4.40(10^{1})$

Table F2-13. 100-BC-1 Waste-site Profile.
(Page 1 of 8)

Waste Site/Group (Retention Basin)	Extent of Contamination					Media/ Material	Refined COPC	Maximum Concentration Detected (a)	Are Reduced Infiltration Concentrations Exceeded?
	Volume (m^3)	Length (m)	Width (m)	Area (m^2)	Depth (m)				
116-B-11	118835.0	210.3	111.3	23406.0	6.1	Soil Concrete	<u>Radionuclides</u>	<u>pCi/g</u>	
							^{14}C	$2.59(10^{2})$	NO
							^{60}Co	$4.39(10^{3})$	NOV
							^{137}Cs	$8.30(10^{2})$	NO
							^{152}Eu	$2.83(10^{4})$	NO
							^{154}Eu	$8.24(10^{3})$	NO
							^{63}Ni	$5.10(10^{4})$	NO
							^{238}Pu	7.66	NO
							$^{239/240}Pu$	$3.40(10^{2})$	NO
							^{90}Sr	$2.10(10^{2})$	NO
							^{238}U	9.00	NO
							<u>Inorganics</u>	<u>mg/kg</u>	
							Arsenic	(e)	YES(b)
							Cadmium		NO
							Chromium VI		YES
							Lead		NO

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Table F2-13. 100-BC-1 Waste-site Profile.
(Page 2 of 8)

Waste Site/Group (Retention Basin)	Extent of Contamination					Media/ Material	Refined COPC	Maximum Concentration Detected (a)	Are Reduced Infiltration Concentrations Exceeded?
	Volume (m^3)	Length (m)	Width (m)	Area (m^2)	Depth (m)				
116-C-5	145210.0	(c)	(c)	23805.0	6.1	Soil	Radionuclides	pCi/g	
						Concrete	^{241}Am	3.40(10^1)	NO
							^{14}C	2.59(10^2)	NO
							^{60}Co	1.95(10^3)	NO
							^{137}Cs	2.15(10^3)	NO
							^{152}Eu	5.75(10^3)	NO
							^{154}Eu	6.53(10^3)	NO
							^{3}H	1.78(10^3)	NO
							^{238}Pu	9.40	NO
							$^{239/240}$Pu	2.30(10^2)	NO
							^{90}Sr	7.70(10^2)	NO
							^{228}Th	4.40	NO
							Inorganics	mg/kg	
							Barium	2.60([illegible])	NO
							Cadmium	8.40(10^{-1})	NO
							Chromium VI	6.09(10^2)	YES
							Lead	5.64(10^2)	NO
							Mercury	4.30	NO
100 B/C Buried Pipelines	302972.0	6533.0	varies	varies	varies	Soil	Radionuclides	pCi/g	
						Steel	^{60}Co	2.81(10^3)	NO
						Concrete	^{137}Cs	1.11(10^5)	NO
						Sludge	^{152}Eu	1.68(10^4)	NO
							^{154}Eu	3.41(10^3)	NO
							^{155}Eu	9.42(10^3)	NO
							^{63}Ni	6.18(10^4)	NO
							^{238}Pu	1.41(10^2)	NO
							$^{239/240}$Pu	2.80(10^3)	YES(d)
							^{90}Sr	2.04(10^3)	NO
100 B/C Pipeline Soil (Leak at Junction Box)	1325.0	76.2	5.8	441.0	3.0	Soil	Radionuclides	pCi/g	
						Concrete	^{60}Co	4.64(10^3)	NO
							$^{239/240}$Pu	1.00(10^1)	NO
							^{90}Sr	1.36(10^2)	NO

Table F2-13. 100-BC-1 Waste-site Profile.
(Page 3 of 8)

Waste Site/Group	Extent of Contamination					Media/ Material	Refined COPC	Maximum Concentration Detected (a)	Are Reduced Infiltration Concentrations Exceeded?
	Volume (m^3)	Length (m)	Width (m)	Area (m^2)	Depth (m)				
116-B-1 (Process Effluent Disposal Trench)	3001.0	112.2	13.1	1470.0	4.6	Soil	<u>Inorganics</u>	<u>mg/kg</u>	
							Chromium VI	$3.30(10^1)$	YES
							Manganese	$8.39(10^2)$	NO
116-C-1 (Process Effluent Disposal Trench)	31441.0	169.8	32.6	5535.0	5.8	Soil Concrete	<u>Radionuclides</u>	<u>pCi/g</u>	
							^{137}Cs	$1.18(10^1)$	NO
							^{152}Eu	6.63	NO
							$^{239/240}Pu$	5.30	NO
							<u>Inorganics</u>	<u>mg/kg</u>	
							Chromium VI	(e)	YES(e)
116-B-13 (Sludge Trench)	924.0	15.2	15.2	228	4.0	Sludge	<u>Radionuclides</u>	(b)	NO(b)
							^{241}Am		(Inclusive)
							^{14}C		
							^{137}Cs		
							^{60}Co		
							^{152}Eu		
							^{154}Eu		
							^{63}Ni		
							^{238}Pu		
							$^{239/240}Pu$		
							^{90}Sr		
							^{228}Th		
							^{3}H		
							^{238}U		
							<u>Inorganics</u>	(b)	YES(b)
							Arsenic		NO
							Barium		NO
							Cadmium		YES
							Chromium VI		NO
							Mercury		NO
							Lead		

**Table F2-13. 100-BC-1 Waste-site Profile.
(Page 4 of 8)**

Waste Site/Group	Extent of Contamination					Media/ Material	Refined COPC	Maximum Concentration Detected (a)	Are Reduced Infiltration Concentrations Exceeded?
	Volume (m^3)	Length (m)	Width (m)	Area (m^2)	Depth (m)				
116-B-14 (Sludge Trench)	439.0	36.6	3.0	110.0	4.0	Sludge	Radionuclides ^{241}Am ^{14}C ^{137}Cs ^{60}Co ^{152}Eu ^{154}Eu ^{63}Ni ^{238}Pu $^{239/240}Pu$ ^{90}Sr ^{228}Th Tritium ^{238}U	b	NO(b) (Inclusive)
							Inorganics Arsenic Barium Cadmium Chromium VI Mercury Lead	b	YES(b) NO NO YES NO NO
116-B-4 (French Drain)	3.2	1.2 (f)	1.2 (f)	1.1	2.7	Soil Steel	Radionuclides ^{60}Co ^{137}Cs ^{152}Eu ^{154}Eu $^{239/240}Pu$	pCi/g 2.68(10²) 2.08(10²) 4.20(10²) 4.54(10¹) 8.60	 NO NO NO NO NO
116-B-12 (Seal Pit Crib)	0.0	0.0	0.0	0.0	0.0	NA	None	e	NO(e)
116-B-5 Crib	1022.0	29.0	8.2	232.0	4.3	Soil Concrete	Radionuclides ^{152}Eu ^{3}H	pCi/g 1.15(10¹) 2.96(10⁴)	 NO NO
							Inorganics Barium Mercury	mg/kg 4.84(10²) 2.90	 NO NO

Table F2-13. 100-BC-1 Waste-site Profile.
(Page 5 of 8)

Waste Site/Group	Extent of Contamination					Media/ Material	Refined COPC	Maximum Concentration Detected (a)	Are Reduced Infiltration Concentrations Exceeded?
	Volume (m^3)	Length (m)	Width (m)	Area (m^2)	Depth (m)				
118-B-5 Ball 3X Burial Ground	3297.0	varies	varies	907.0	6.1	Misc. Solid Waste	Radionuclides ^{14}C ^{137}Cs ^{60}Co ^{152}Eu ^{154}Eu ^{63}Ni ^{90}Sr ^{3}H Inorganics Cadmium Lead Mercury Organics -no specific constituents identified, but 5% of volume is assumed to be contaminated by organics	(h)	NO(g)

Table F2-13. 100-BC-1 Waste-site Profile.
(Page 6 of 8)

Waste Site/Group	Extent of Contamination					Media/ Material	Refined COPC	Maximum Concentration Detected (a)	Are Reduced Infiltration Concentrations Exceeded?
	Volume (m^3)	Length (m)	Width (m)	Area (m^2)	Depth (m)				
118-B-7 Burial Ground	61.0	7.3	7.3	46	2.4	Misc. Solid Waste	<u>Radionuclides</u> ^{14}C ^{137}Cs ^{60}Co ^{152}Eu ^{154}Eu ^{63}Ni ^{90}Sr ^{3}H <u>Inorganics</u> Cadmium Lead Mercury <u>Organics</u> -no specific constituents identified, but 5% of volume is assumed to be contaminated by organics	(h)	NO(g)

Table F2-13. 100-BC-1 Waste-site Profile.
(Page 7 of 8)

Waste Site/Group	Extent of Contamination					Media/ Material	Refined COPC	Maximum Concentration Detected (a)	Are Reduced Infiltration Concentrations Exceeded?
	Volume (m^3)	Length (m)	Width (m)	Area (m^2)	Depth (m)				
118-B-10 Burial Ground	1346.0	26.8	17.7	402	6.1	Misc. Solid Waste	<u>Radionuclides</u> ^{14}C ^{137}Cs ^{60}Co ^{152}Eu ^{154}Eu ^{63}Ni ^{90}Sr ^{3}H <u>Inorganics</u> Cadmium Lead Mercury <u>Organics</u> -no specific constituents identified, but 5% of volume is assumed to be contaminated by organics	(h)	NO(g)
132-B-4 Filter Building (D&D Facility)	0	0	0	0	0	NA	None	NA	NA

Table F2-13. 100-BC-1 Waste-site Profile.
(Page 8 of 8)

Waste Site/Group	Extent of Contamination					Media/ Material	Refined COPC	Maximum Concentration Detected (a)	Are Reduced Infiltration Concentrations Exceeded?
	Volume (m^3)	Length (m)	Width (m)	Area (m^2)	Depth (m)				
132-B-5 Gas Recirculation Building (D&D Facility)	0	0	0	0	0	NA	None	NA	NA

a Where concentration exceeds PRG.
b Based on retention basin group data.
c Contamination is defined by an additional 12.2 m (40 ft) radius beyond the retention basin walls
d Data is from pipeline sludge. Although the in situ PRG are exceeded, impact to groundwater is expected to be negligible due to containment of the material by the pipe.
e Based on Process Document group data.
f 1.2 m (4 ft) is the diameter of the french drain
g Assumed to meet in situ PRG.
h No quantitative data is available. Constituents are assumed from Miller and Wahlen 1987.

PRG = preliminary remediation goals
COPC = contaminants of potential concern
NA = not applicable
Dimensions = Contaminated volume dimensions from Appendix A.
D&D = decontamination and decommissioning

3.0 RESULTS OF THE PLUG-IN APPROACH

This Section describes how the analysis of remedial alternatives for the waste site groups in the Process Document is used in lieu of doing independent analyses for the individual waste sites. The waste sites in the 100 Area source Operable Units were categorized into ten waste site groups , then several remedial alternatives for cleaning up each of the waste site groups were evaluated (see Sections 3.0, 4.0, and 5.0 of the Process Document). To implement the "plug-in" approach, the first step is to identify which waste site group an individual waste site appears to belong to. This is accomplished by comparing the profiles of the individual waste sites presented in Table 2-13 of this FFS to the waste site group descriptions and group profiles given in Section 3.1 and Table 3-1 of the Process Document. The results of this process for the 100-BC-1 Operable Unit are:

Individual Waste Site (100-BC-1)	Waste Site Group
116-B-11	Retention Basin
116-C-5	Retention Basin
100 B/C Buried Pipelines	Buried Pipelines
100 B/C Pipeline Soil	Buried Pipelines
116-B-1	Process Effluent Trench
116-C-1	Process Effluent Trench
116-B-13	Sludge Trench
116-B-14	Sludge Trench
116-B-4	French Drain
116-B-12	Seal Pit Crib
116-B-5	Special Crib
118-B-5	Burial Ground
118-B-7	Burial Ground
118-B-10	Burial Ground
132-B-5	D & D Facility
132-B-4	D & D Facility

The next step in the process is to determine if the individual waste site characteristics meet the applicability criteria for the remedial alternatives for that waste site group (see Table 4-2 in the Process Document). If the individual waste site characteristics match the group profile and the applicability criteria completely, there are no deviations from the analysis in the Process Document. In this case the analysis of alternatives in the Process Document is adequate for the individual waste site, and the individual waste site plugs into the existing alternatives analysis in the Process Document. If there are deviations, then further analyses of that waste site are conducted in Sections 4.0, 5.0, and 6.0 of this Appendix.

3.1 EXAMPLE OF THE PLUG-IN APPROACH

Implementing the plug-in approach for the 116-B-1 waste site is presented here as an example to clarify the process. The process steps are described in Section 1.4 of the Process Document, and the example below illustrates steps 5 and 6 described in that Section. First, the 116-B-1 waste site is identified as a process effluent trench. Table 2.2 indicates that the site received highly contaminated cooling water effluent diverted from the retention basins and that the site is an unlined trench. Site 116-B-1, therefore, belongs in the process effluent trench group.

The alternative applicability criteria are evaluated below based on the description and profile developed for waste site 116-B-1 in section 2.0.

No Action - There is data indicating that there is contamination present at the site which warrants an interim action. Therefore, no action is not an appropriate alternative.

Institutional Controls - Refined COPC are identified for waste site 116-B-1 on Table 2-6 indicating there are contaminants present which exceed preliminary remediation goals. Therefore, institutional controls will not effectively address contaminants at the site.

Containment - Table 2-13 indicates that waste site 116-B-1 contains contaminants which exceed infiltration concentrations. Therefore, containment is not applicable at this site.

Removal/Disposal - Contaminants exceed preliminary remediation goals; therefore, this alternative may be applicable.

Insitu Treatment - Contaminants exceed preliminary remediation goals, and the contaminated lens is <5.8 m (19 ft); therefore, insitu treatment may be applicable.

Removal/Treatment/Disposal - Contaminants exceed preliminary remediation goals; therefore, this option may be applicable. The thermal desorption enhancement is not necessary because there are no organic contaminants present at the site. Soil washing is the most likely treatment method.

The next step is to compare the 116-B-1 waste site characteristics to the applicability criteria for the remedial alternatives shown in Table 4-2 of the Process Document. The analysis conducted in the Process Document determined that three remedial alternatives were appropriate for process effluent trench group: removal/disposal, insitu treatment, and removal/treatment/disposal.
The applicable remedial alternative for the 116-B-1 waste site are identical to those for the effluent disposal trench group; therefore, the site completely plugs into the analyses for that waste site group.

3.2 RESULTS OF THE PLUG-IN APPROACH

The characteristics and profiles of the 100-BC-1 individual waste sites were compared to the applicability criteria for the remedial alternatives (as shown in Table 4-2 of the Process Document), and the results of this evaluation are shown on Table 3-1. Retention basin 116-C-5 is characterized by organic contaminants, a deviation; therefore, thermal desorption was added as an enhancement to the removal/treatment/disposal remedial alternative.

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Table F3-1. Comparison of Waste Sites and Alternatives. (Page 1 of 2)

Waste Site Group		132-B-4 132-B-5 D&D Facility	116-B-11 Retention Basin	116-C-5 Retention Basin	BURIED PIPE-LINES Pipeline*	116-B-1 Process Effluent Trench
Alternative	**Applicability Criteria and Enhancements**	**Are Applicability Criteria and Enhancements Met?**				
No Action						
SS-1 SW-2	Criterion: • Has site been effectively addressed in the past?	Yes	No	No	No	No
Institutional Controls						
SS-2 SW-2	Criterion: • Contaminants < PRG	Yes	No	No	No	No
Containment						
SS-3 SW-3	Criteria: • Contaminants > PRG	No	Yes	Yes	Yes	Yes
	• Contaminants < reduced infiltration concentrations	No	No	No	Yes	No
Removal/Disposal						
SS-4 SW-4	Criterion: • Contaminants > PRG	No	Yes	Yes	Yes	Yes
In Situ Treatment						
SS-8A	Criteria: • Contaminants > PRG	No	Yes	Yes	NA	Yes
	• Contamination < 5.8 m in depth	NA	No	No	NA	Yes
SS-8B	Criteria: • Contaminants > PRG	NA	NA	NA	Yes	NA
	• Contaminants < reduced infiltration concentrations	NA	NA	NA	Yes	NA
SW-7	Criteria: • Contaminants > PRG	NA	NA	NA	NA	NA
	• Contaminants < reduced infiltration concentrations	NA	NA	NA	NA	NA
Removal/Treatment/Disposal						
SS-10	Criterion: • Contaminants > PRG	No	Yes	Yes	Yes	Yes
	Enhancements: • Organic contaminants (if yes, thermal desorption must be included in the treatment system)	NA	No	Yes(d)	No	No
	• Percentage of contaminated volume less than twice the PRG for cesium-137		33%	33%	100%	100%
SW-9	Criterion: • Contaminants > PRG	NA	NA	NA	NA	NA
	Enhancement: • Organic contaminants	NA	NA	NA	NA	NA

Table F3-1. Comparison of Waste Sites and Alternatives. (Page 2 of 2)

Waste Site Group		116-C-1 Process Effluent Trench	116-B-13 116-B-14 Sludge Trench	116-B-4 Dummy Decon/ French Drain	116-B-12 Seal Pit Crib	116-B-5 Special Crib	118-B-5 118-B-7 118-B-10 Burial Ground
Alternative	**Applicability Criteria and Enhancements**	**Are Applicability Criteria and Enhancements Met?**					
No Action							
SS-1 SW-2	Criterion: • Has site been effectively addressed in the past?	No	No	No	Yes	No	No
Institutional Controls							
SS-2 SW-2	Criterion: • Contaminants < PRG	No	No	No	No	No	No
Containment							
SS-3 SW-3	Criteria: • Contaminants > PRG • Contaminants < reduced infiltration concentrations	Yes No	Yes No	Yes Yes	NA NA	Yes Yes	Yes Yes
Removal/Disposal							
SS-4 SW-4	Criterion: • Contaminants > PRG	Yes	Yes	Yes	NA	Yes	Yes
In Situ Treatment							
SS-8A	Criteria: • Contaminants > PRG • Contamination < 5.8 m (19 ft) in depth	Yes Yes	Yes Yes	Yes Yes	NA NA	Yes Yes	NA NA
SS-8B	Criteria: • Contaminants > PRG • Contaminants < reduced infiltration concentrations	NA NA	NA NA	NA NA	NA NA	NA NA	NA NA
SW-7	Criteria: • Contaminants > PRG • Contaminants < reduced infiltration concentrations	NA NA	NA NA	NA NA	NA NA	NA NA	Yes Yes
Removal/Treatment/Disposal							
SS-10	Criterion: • Contaminants > PRG	Yes	Yes	Yes	NA	Yes	NA
	Enhancements: • Organic contaminants (if yes, thermal desorption must be included in the treatment system) • Percentage of contaminated volume < twice the PRG for ^{137}Cs	No 0%	No 67%	No 67%	NA NA	No 100%	NA NA
SW-9	Criterion: • Contaminants > PRG	NA	NA	NA	NA	NA	Yes
	Enhancement: • Organic contaminants	NA	NA	NA	NA	NA	Yes

NA - Not Applicable d - deviation from waste group PRG - Preliminary Remediation Goals Decon - decontamination
[a]Includes all buried pipelines and leak at junction box.

4.0 ALTERNATIVE DEVELOPMENT

This section identifies sites in the 100-BC-1 Operable Unit that completely match ("plug in") with their corresponding waste site groups in the Process Document. It also identifies those sites that don't match.

Sites that match completely plug directly into the the analysis of alternatives for the waste site group conducted in the Process Document (see Section 1.4, step 6a). Sites that meet this requirement include 116-B-11, buried pipelines, 116-B-1, 116-C-1, 116-B-13, 116-B-14, 116-B-4, 116-B-12, 118-B-5, 188-B-7, 118-B-10, 132-B-4, and 132-B-5. The 116-B-5 waste site is considered a special crib due to its unique waste stream. Because the special crib category contains sites associated with unique projects or facilities, they must be addressed individually, and no group profile is developed. However, in the case of waste site 116-B-5, it is apparent that the alternatives are consistent with the dummy decontamination crib/french drain group.

Sites that do not plug in directly (Process Document, Section 1.4, Step 6b) can be divided into two groups. The first group includes sites that require enhancements to an alternative or an inclusion, or dismisal of an alternative as originally proposed. The site that meets this requirement and applicable deviation is 116-C-5 retention basin waste site. The 116-C-5 waste site requires thermal desorption as an enhancement option to the Removal/Treatment/Disposal Alternative; therefore, additional development of the technology and alternative are not required because the Process Document incorporates the appropriate enhancements in section 1.4.

The second group of sites that do not plug in are those sites that require a significant modification to an alternative, such as changes in the excavation process or disposal options. Alternatives for sites included in this second set will require additional development. None of the sites within the 100-BC-1 Operable Unit fit into this second set; therefore, additional alternative development is not required.

5.0 DETAILED ANALYSIS OF ALTERNATIVES

This section evaluates the advantages and disadvantages of implementing the remedial alternatives applicable to the individual waste sites within the 100-BC-1 Operable Unit. In the detailed analysis, each alternative is assessed against the evaluation criteria described in Section 5.1 of the Process Document. The detailed analysis provides a basis to compare the alternatives and to support a subsequent evaluation of the alternatives made by the decision makers in the remedy selection process.

This analysis for the sites within 100-BC-1 Operable Unit is presented in the following manner:

- The detailed analyses for waste sites that do not deviate from the waste site groups are referenced to the group discussion presented in the Process Document (see Table F5-1).
- The detailed analyses for waste sites that deviate from the waste site groups are discussed in Section 5.2.

Based on the comparison presented in Table F3-1, most of the individual waste sites within 100-BC-1 Operable Unit plug into the waste site group alternatives; therefore, the detailed analysis for these individual waste sites can be referenced to the Process Document. These individual waste sites include 116-B-11, pipelines, 116-B-1, 116-C-1, 116-B-13, 116-B-14, 116-B-4, 116-B-12, 118-B-5, 118-B-7, 118-B-10, 132-B-4, and 132-B-5. The 116-B-5 waste site is considered a special crib because of its unique waste stream. Because the special crib category contains sites associated with unique projects or facilities, they must be addressed individually, and no group profile is developed. However, in the case of waste site 116-B-5, based on the evaluation in Table F3-1, it is apparent that the detailed analysis for the dummy decontamination crib/french drain group can be assumed for this site.

5.1 SITE-SPECIFIC COMMON EVALUATION CONSIDERATIONS

This section evaluates the alternatives that deviate from the Process Document for the 116-C-5 retention basin site against the NEPA evaluation criteria. Alternatives SS-4 and SS-10 are applicable to this site. Alternative SS-10 deviates from the waste site group analysis in that thermal desorption is included as an enhancement to the treatment process.

Alternative SS-10, which includes thermal desorption, would impact transportation. This alternative would require the transport of equipment, contaminated and solid waste, and clean fill by truck onsite. The commuter traffic flow for this alternative would be considered an impact in the 100 Area.

The thermal desorption included in this alternative may impact air quality. Organics present at waste site 116-C-5 may be emitted during the thermal desorption process.

However, mitigative measures would be employed as needed to ensure that these potential short-term impacts on air quality are minor and acceptable.

Excavation, thermal desorption, and disposal of the contaminated soil from the 116-C-5 retention basin would not impact ecological resources. In fact, revegetation and restoration efforts would, in the long-term, benefit natural resources.

The potential of this alternative for disturbing cultural resources is considered high. Actions to mitigate adverse impacts on significant cultural resources would have to be taken before implementing this alternative.

The socioeconomic impact of this alternative would be insignificant. The number of employees involved and the income gained would be insignificant when compared with the total Tri-Cities area employment. Workers would likely come from the regional labor force. Consistent with overall employment, income, and population impact effects on housing would be insignificant.

This alternative would create minor short-term impacts to noise and visual resources during the treatment process. Noise mitigation would be provided should noise levels become a problem. In an effort to mitigate potential impacts to visual resources, dust controls and backfilling with clean soil then contouring and revegetating would be implemented when needed.

Resources, such as federal funds, imported soil and rock for soil cover, and consumables such as fuel, electricity, chemicals, and personal protective equipment would be irreversibly committed.

The indirect impact of this alternative would be an enhancement of the natural resources through revegetation. This alternative could add to the cumulative impact on transportation and cultural, noise and visual resources from Hanford Site remediation.

As stated in the Process Document, this alternative may comply with Executive Order 12898, Environmental Justice. Excavation always poses the risk of unearthing Native American burials. This risk of an adverse impact on Native American cultural resources may be disproportionately large compared to other segments of the population. This alternative would protect groups of the population with higher fish consumption patterns than the general population from contamination at the 116-C-5 retention basins.

5.2 DETAILED ANALYSIS

This section evaluates the alternatives that deviate from the Process Document for the 116-C-5 retention basin site against the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) evaluation criteria. Alternatives SS-4 and SS-10 are applicable to this site. However, only Alternative SS-10 deviates from the Process Document, and therefore, will be evaluated.

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5.2.1 Overall Protection of Human Health and the Environment

Based on the presence of pentachlorophenol, alternative SS-10 requires that thermal desorption be included for this waste site. The removal/treatment/disposal technologies associated with the thermal desorption enhancement of alternative SS-10 will result in protection of human health and the environment. Any potential additional short-term risk to the workers or the community can be minimized through engineering controls and proper health and safety protocol.

5.2.2 Compliance with ARAR

Chemical-specific ARAR for alternative SS-10 will be met by desorption of organic compounds from the soil. Location-specific ARARs can be met through proper planning and scheduling. Action-specific ARARs are met through appropriate design and operation.

5.2.3 Long-term Effectiveness and Permanence

The addition of thermal desorption to alternative SS-10 does not change the analysis of this alternative with respect to this criterion from the Process Document. Contaminated soil exceeding PRG will be permanently removed from the site.

5.2.4 Reduction of Toxicity, Mobility, or Volume

Thermal desorption is primarily an irreversible process in which nearly all of the volatile and semivolatile constituents will be reduced. Any remaining volatile and semivolatile organic contaminants will be rendered immobile. Thermal desorption may completely reduce the volume of soil, producing minimal amounts of residuals that will be transferred to a disposal facility.

5.2.5 Short-term Effectiveness

Risks to the community and workers during thermal desorption include potential releases of fugitive gases. These releases can be controlled through vapor abatement and proper operating procedures. No receptors are currently in the area. However, remedial activities can be scheduled to accommodate nesting or roosting species if encountered. All remedial action objectives are met upon completion of Remedial Alternative.

5.2.6 Implementability

No difficulties are anticipated with the implementation of thermal desorption despite the absence of site-specific treatability study data. An influent soil particle size limitation of 6 cm (2 in.) exists. It is very unlikely that technical problems will lead to schedule delays. All necessary equipment and specialists are readily available and adjustments to alternative SS-10 are easily accomplished as thermal desorption will be an off-line process. Because of removal, postclosure monitoring will not be required.

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Table F5-1. Waste Site Remedial Alternatives and Technologies.

Alternatives		Technologies Included	Waste Site and Associated Group								
			116-B-11 Retention Basin	116-C-5 Retention Basin	100 B/C Buried Pipelines *	116-B-1 & 116-C-1 Process Effluent Trenches	116-B-13 & 116-B-14 Sludge Trenches	[1]116-B-4 French Drain & 116-B-5 Special Crib	118-B-5, 118-B-7, & 118-B-10 Burial Grounds	132-B-4 & 132-B-5 Demolished Facility	116-B-12 Seal Pit Crib
No Action	SS-1 SW-1	None								P	P
Institutional Controls	SS-2 SW-2	Deed Restrictions									
		Groundwater Monitoring									
Containment	SS-3 SW-3	Surface Water Controls			P			P	P		
		Barrier			P			P	P		
		Deed Restrictions			P			P	P		
		Groundwater Monitoring			P			P	P		
Removal, Disposal	SS-4 SW-4	Removal	P	P	P	P	P	P	P		
		Disposal	P	P	P	P	P	P	P		
In Situ Treatment	SS-8A	Surface Water Controls				P	P	P			
		In Situ Vitrification				P	P	P			
		Groundwater monitoring				P	P	P			
		Deed Restrictions				P	P	P			
	SS-8B	Void Grouting			P						
		Barrier			P						
		Surface Water Controls			P						
		Deed Restrictions			P						
		Groundwater Monitoring			P						
	SW-7	Dynamic Compaction							P		
		Barrier							P		
		Surface Water Controls							P		
		Groundwater Monitoring							P		
		Deed Restrictions							P		
Removal, Treatment, Disposal	SS-10	Removal	P	P	P	P	P	P			
		Thermal Desorption		P, O							
		Soil Washing	P	P	P	P	P	P			
		Disposal	P	P	P	P	P	P			
	SW-9	Removal							P		
		Thermal Desorption							P		
		Compaction							P		
		ERDF Disposal							P		

Note: [1]116-B-4 French Drain and 116-B-5 are in "Special Crib Group," whose alternatives are consistent with the Dummy Decon Crib - French Drain Group.

P - Indicates the detailed analysis which is provided in the Process Document
O - Indicates the detailed analysis which is provided in the operable unit-specific report
blank - Technology does not apply to this Waste Site
ERDF - Environmental Restoration Disposal Facility
* Includes pipelines and leak at junction box.

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Table F5-2. 100-BC-1 Site-Specific Alternative Costs.

Site	Containment			Removal/Disposal			In Situ Treatment			Removal/Treatment/Disposal		
	Capital	O&M	Present Worth	Capital	O&M	Present Worth	Capital	O&M	Present Worth	Capital	O&M	Present Worth
100-BC-1 OPERABLE UNIT												
116-B-11 Retention Basin				$5.05E+07	$0.00E+00	$4.81E+07				$5.16E+07	$7.69E+06	$5.55E+07
116-C-5 Retention Basin				$5.90E+07	$0.00E+00	$5.62E+07				$6.87E+07	$1.19E+07	$7.52E+07
116-B-13 Sludge Trench				$8.65E+05	$0.00E+00	$8.26E+05	$1.77E+06	$9.37E+05	$2.58E+06	$1.29E+06	$1.14E+05	$1.35E+06
116-B-14 Sludge Trench				$7.53E+05	$0.00E+00	$7.20+05	$1.39E+06	$6.13E+05	$1.91E+06	$1.18E+06	$7.83E+04	$1.20E+06
116-B-1 Process Effluent Trench				$3.13E+06	$0.00E+00	$2.99E+06	$6.59E+06	$4.33E+06	$1.04E+07	$3.43E+06	$5.85E+05	$3.83E+06
116-C-1 Process Effluent Trench				$1.65E+07	$0.00E+00	$1.57E+07	$3.39E+07	$2.77E+07	$5.48E+07	$1.73E+07	$1.45E+06	$1.79E+07
116-B-5 Crib	$7.05E+05	$2.68E+05	$8.23E+05	$1.13E+06	$0.00E+00	$1.08E+06	$2.19E+06	$1.24E+06	$3.28E+06	$1.50E+06	$1.68E+05	$1.60E+06
116-B-4 French Drain	$4.01E+05	$1.25E+05	$4.54E+05	$2.95E+05	$0.00E+00	$2.83E+05	$6.32E+05	$1.13E+05	$7.15E+05	$7.21E+05	$1.14E+04	$7.07E+05
116-B-12 Seal Pit Crib	Institutional Controls proposed at site											
100 B/C PIPELINES	$4.70E+07	$2.18E+07	$5.46E+07	$3.61E+07	$0.00E+00	$3.29E+07	$7.04E+06	$3.88E+06	$8.87E+06	$3.81E+07	$5.78E+06	$4.00E+07
118-B-5 Burial Ground	$1.14E+06	$4.75E+05	$1.35E+06	$1.88E+06	$0.00E+00	$1.79E+06	$1.34E+06	$5.30E+05	$1.57E+06	$2.00E+06	$1.00E+05	$2.01E+06
118-B-7 Burial Ground	$5.16E+05	$1.80E+05	$5.94E+05	$2.31E+05	$0.00E+00	$2.22E+05	$5.99E+05	$1.95E+05	$6.82E+05	$7.47E+05	$1.48E+04	$7.38E+05
118-B-10 Burial Ground	$8.74E+05	$3.50E+05	$1.03E+06	$1.00E+06	$0.00E+00	$9.58E+05	$1.03E+06	$3.91E+05	$1.20E+06	$1.37E+06	$5.11E+04	$1.37E+06
132-B-4 D&D Facility	No interim action proposed at site											
132-B-5 D&D Facility	No interim action proposed at site											

NOTES:

- Costs are in millions of dollars
- O&M - Operation and Maintenance
- NA - Not Applicable to the Waste Site (see FFS Report)
- Costs presented are based on a different exposure scenario than the selected scenario, but the relative differences between alternatives is similar (see FFS Report for detailed cost analysis).
- Costs presented are preliminary, and are presented for comparison purposes only. It is expected that actual costs will be significantly lower.

Table F5-3. 100-BC-1 Site-Specific Alternative Durations.

Site	Containment	Removal/Disposal	In Situ Treatment	Removal/Treatment/Disposal
	Duration (yr)	Duration (yr)	Duration (yr)	Duration (yr)
100-BC-1 OPERABLE UNIT				
116-B-11 Retention Basin		0.7		1.5
116-C-5 Retention Basin		0.7		1.7
116-B-13 Sludge Trench		0.1	0.2	0.1
116-B-14 Sludge Trench		0.1	0.2	0.1
116-B-1 Process Effluent Trench		0.1	0.7	0.2
116-C-1 Process Effluent Trench		0.5	3.8	0.6
116-B-5 Crib	0.1	0.1	0.2	0.1
116-B-4 French Drain	0.1	0.1	0.1	0.1
116-B-12 Seal Pit Crib	Institutional Controls proposed at site			
100 B/C PIPELINES	2.4	2.4	0.2	2.5
118-B-5 Burial Ground	0.1	0.1	0.1	0.1
118-B-7 Burial Ground	0.1	0.1	0.1	0.1
118-B-10 Burial Ground	0.1	0.1	0.2	0.1
132-B-4 D&D Facility	No interim action proposed at site			
132-B-5 D&D Facility	No interim action proposed at site			

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6.0 COMPARATIVE ANALYSIS

This section presents the comparative analysis of Remedial Alternatives that involves evaluation of the relative performance of each alternative compared to the evaluation criteria presented in Section 6.0 of the Process Document. This comparison identifies the advantages and disadvantages of each alternative so that key trade-offs can be identified.

Following the methodology of the Process Document, the comparative analysis of the 100-BC-1 alternatives is presented in quantitative format (Tables F6-1 through F6-6). The tables present the alternatives applicable to each waste site and a comparison of the differences between each alternative. The comparison includes identifying the relative rank of the alternative (relative to other applicable alternatives) along with the cost[1]. The preferred alternative is the alternative that ranks the highest overall for each waste site.

Institutional controls are identified as the only applicable alternative for the 116-B-12 seal pit crib (see Section 5.0 of this document and the Process Document). Because there are no other alternatives to compare against, the site is not included in the comparative analysis. Likewise, the Process Document identifies no action for the D&D group, such as 132-B-4 and 132-B-5. Thus, these sites are also not presented in the following tables.

6.1 QUANTITATIVE COMPARISON OF REMEDIAL ALTERNATIVES

6.1.1 Retention Basins

The Process Document comparative analysis for retention basins ranked Removal/Disposal ahead of Removal/Treatment/Disposal as potential Remedial Alternatives. When site-specific costs associated with 116-C-5 and 116-B-11 were applied to the comparative analysis in accordance with Table 6-3 of the Process Document, Removal/Disposal still ranked ahead of Removal/Treatment/Disposal. Costs associated with the 116-B-11 resulted in a one-point increase in the total ranking for the Removal/Treatment/Disposal Alternative.

The 116-C-5 retention basin contains pentachlorophenol that will be treated using thermal desorption. The addition of thermal desorption to the treatment process increases the score for the Reduction in Toxicity, Mobility, and Volume through treatment by one point. The additional process slightly reduces the short-term effectiveness, implementability, and cost categories. This reduction is so slight that a reduction in the score originally given to these categories is not warranted. The results of the comparative analysis for the 116-C-5 and 116-B-11 retention basins are shown in Tables F6-1 and F6-2, respectively.

[1]Estimates of durations for each alternative are presented in Section 5.0, Table F5-3.

6.1.2 Process Effluent Trenches

The Process Document comparative analysis for process effluent trenches ranked the Remedial Alternatives as follows: Removal/Disposal, Removal/Treatment/Disposal, and In Situ Vitrification. When site-specific costs associated with the 116-C-1 and 116-B-1 process effluent trenches were applied to the comparative analyses in accordance with Table 6-3 of the Process Document, there was no change to the relative ranking of the alternatives. However, the total rank of the Removal/Treatment/Disposal Alternative was reduced by one point. The results are shown in Tables F6-3 and F6-4.

6.1.3 Sludge Trenches

The Process Document comparative analysis for sludge trenches ranked the Remedial Alternatives as follows: Removal/Disposal, Removal/Treatment/Disposal, and In Situ Vitrification. When site-specific costs associated with the 116-B-13 and 116-B-14 sludge trenches were applied to the comparative analysis in accordance with Table 6-3 of the Process Document, there was no change to the relative rankings of the alternatives.

The cost rank of the Removal/Treatment/Disposal Alternative for 116-B-13 was reduced one point, as was the total rank of the alternative. The cost rank of the Removal/Treatment/Disposal Alternative for 116-B-14 was reduced one point and the cost rank of the In Situ Vitrification Alternative was increased one point. The results are shown in Tables F6-5 and F6-6.

6.1.4 Dummy Decontamination Cribs and French Drains

The Process Document comparative analysis for dummy decontamination cribs and French drains ranked the Remedial Alternatives as follows: Removal/Disposal, Removal/Treatment/Disposal, In Situ Vitrification, and Containment. Site-specific costs associated with the 116-B-4 French drain applied to the comparative analysis in accordance with Table 6-3 of the Process Document changed the relative rankings as follows: Removal/Disposal, Removal/Treatment/Disposal, Containment, and In Situ Vitrification. The change in ranking was because of the relatively low cost of the Containment Remedial Alternative for 116-B-4.

The 116-B-5 special crib is in the same facility group as the 116-B-4 French drain. Applying the 116-B-5 costs to the comparative analysis in accordance with Table 6-3 of the Process Document resulted in the following ranking: Removal/Disposal, Removal/Treatment/Disposal, Containment, and In Situ Vitrification. The total scores of all but the In Situ Vitrification were very close. The results for 116-B-4 and 116-B-5 are shown in Tables F6-7 and F6-8.

6.1.5 Pipelines

The Process Document comparative analysis for pipelines ranked the Remedial Alternatives as follows: Removal/Treatment/Disposal, Removal/Disposal, In Situ Grouting, and Containment. When the 100 B/C specific costs were applied to the comparative analysis in accordance with Table 6-3 of the Process Document, the Removal/Disposal Alternative ranked one point ahead of Removal/Treatment/Disposal with In Situ Grouting third and Containment a distant fourth. The results are shown in Table F6-9.

6.1.6 Burial Grounds

The Process Document comparative analysis of Remedial Alternatives for burial grounds ranks the alternatives as follows: Removal/Disposal, Removal/Treatment/Disposal, Containment, and In Situ Compaction. When site-specific costs were applied to the comparative analysis in accordance with Table 6-3 of the Process Document, the relative rankings were not changed for the 118-B-7 and 118-B-10 burial grounds. However, the rankings of Remedial Alternatives for the 118-B-5 burial ground were changed to the following: Containment, Removal/Disposal, Removal/Treatment/Disposal, and In Situ Compaction. The results are shown in Tables F6-10, F6-11, and F6-12.

Table F6-1. Quantitative Comparison of Evaluation Criteria for 116-C-5 Retention Basin.

CERCLA Evaluation Criteria	Remedial Alternatives					
	Removal/Disposal			Removal/Treatment/Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	7.00	7.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	4.00	2.00	0.50	6.00	3.0
Short-term Effectiveness	0.50	6.00	3.00	0.50	3.00	1.50
Implementability	1.00	9.00	9.00	1.00	5.00	5.00
Cost	1.00	10.00	10.00	1.00	9.00	9.00
Total Rank[b]			31.0			27.0

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

Table F6-2. Quantitative Comparison of Evaluation Criteria for 116-B-11 Retention Basin.

CERCLA Evaluation Criteria	Remedial Alternatives					
	Removal/Disposal			Removal/Treatment/Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	7.00	7.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	4.00	2.00	0.50	5.00	2.5
Short-term Effectiveness	0.50	6.00	3.00	0.50	3.00	1.50
Implementability	1.00	9.00	9.00	1.00	5.00	5.00
Cost	1.00	10.00	10.00	1.00	8.00	9.00
Total Rank[b]			31.0			27.0

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

Table F6-3. Quantitative Comparison of Evaluation Criteria for 116-C-1 Process Effluent Trench.

CERCLA Evaluation Criteria	Remedial Alternatives								
	Removal/Disposal			In Situ Vitrification			Removal/Treatment/ Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	7.00	7.00	1.00	4.00	4.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	3.00	1.5	0.50	7.00	3.5	0.50	5.00	2.5
Short-term Effectiveness	0.50	7.00	3.50	0.50	7.00	3.50	0.50	3.00	1.50
Implementability	1.00	7.00	7.00	1.00	2.00	2.00	1.00	5.00	5.00
Cost	1.00	10.00	10.00	1.00	3.00	3.00	1.00	9.00	9.00
Total Rank[b]			29.0			16.0			27.0

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

Table F6-4. Quantitative Comparison of Evaluation Criteria for 116-B-1 Process Effluent Trench.

CERCLA Evaluation Criteria	Remedial Alternatives								
	Removal/Disposal			In Situ Vitrification			Removal/Treatment/ Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	7.00	7.00	1.00	4.00	4.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	3.00	1.5	0.50	7.00	3.5	0.50	5.00	2.5
Short-term Effectiveness	0.50	7.00	3.50	0.50	7.00	3.50	0.50	3.00	1.50
Implementability	1.00	7.00	7.00	1.00	2.00	2.00	1.00	5.00	5.00
Cost	1.00	10.00	10.00	1.00	3.00	3.00	1.00	9.00	8.00
Total Rank[b]			29.0			16.0			26.0

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

Table F6-5. Quantitative Comparison of Evaluation Criteria for 116-B-13 Sludge Trench.

CERCLA Evaluation Criteria	Remedial Alternatives								
	Removal/Disposal			In Situ Vitrification			Removal/Treatment/ Disposal		
	Weight	Score	Rank[(a)]	Weight	Score	Rank[(a)]	Weight	Score	Rank[(a)]
Long-term Effectiveness	1.00	7.00	7.00	1.00	4.00	4.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	3.00	1.5	0.50	7.00	3.5	0.50	5.00	2.5
Short-term Effectiveness	0.50	7.00	3.50	0.50	7.00	3.50	0.50	5.00	2.50
Implementability	1.00	7.00	7.00	1.00	3.00	3.00	1.00	5.00	5.00
Cost	1.00	10.00	10.00	1.00	3.00	3.00	1.00	6.00	6.00
Total Rank[(b)]			29.0			17.0			25.0

[(a)]Rank = weight x score
[(b)]Total Rank = sum of individual rankings

Table F6-6. Quantitative Comparison of Evaluation Criteria for 116-B-14 Sludge Trench.

CERCLA Evaluation Criteria	Remedial Alternatives								
	Removal/Disposal			In Situ Vitrification			Removal/Treatment/ Disposal		
	Weight	Score	Rank[(a)]	Weight	Score	Rank[(a)]	Weight	Score	Rank[(a)]
Long-term Effectiveness	1.00	7.00	7.00	1.00	4.00	4.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	3.00	1.5	0.50	7.00	3.5	0.50	5.00	2.5
Short-term Effectiveness	0.50	7.00	3.50	0.50	7.00	3.50	0.50	5.00	2.50
Implementability	1.00	7.00	7.00	1.00	3.00	3.00	1.00	5.00	5.00
Cost	1.00	10.00	10.00	1.00	3.00	4.00	1.00	7.00	6.00
Total Rank[(b)]			29.0			18.0			25.0

[(a)]Rank = weight x score
[(b)]Total Rank = sum of individual rankings

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Table F6-7. Quantitative Comparison of Evaluation Criteria for 116-B-5 (Special Crib).

CERCLA Evaluation Criteria	Remedial Alternatives											
	Containment			Removal/Disposal			In Situ Vitrification			Removal/Treatment/Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	3.00	3.00	1.00	7.00	7.00	1.00	4.00	4.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	2.00	1.0	0.50	3.00	1.5	0.50	7.00	3.5	0.50	5.00	2.50
Short-term Effectiveness	0.50	9.00	4.50	0.50	8.00	4.00	0.50	7.00	3.50	0.50	6.00	3.00
Implementability	1.00	6.00	6.00	1.00	8.00	8.00	..00	3.00	3.00	1.00	6.00	6.00
Cost	10.00	1.00	10.0	1.00	10.00	8.00	.00	3.00	3.00	1.00	5.00	5.00
Total Rank[b] Score			24.5			28.5			17.0			25.5

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

Table F6-8. Quantitative Comparison of Evaluation Criteria for 116-B-4 French Drains.

CERCLA Evaluation Criteria	Remedial Alternatives											
	Containment			Removal/Disposal			In Situ Vitrification			Removal/Treatment/Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	3.00	3.00	1.00	7.00	7.00	1.00	4.00	4.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	2.00	1.0	0.50	3.00	1.5	0.50	7.00	3.5	0.50	5.00	2.50
Short-term Effectiveness	0.50	9.00	4.50	0.50	8.00	4.00	0.50	7.00	3.50	0.50	6.00	3.00
Implementability	1.00	6.00	6.00	1.00	8.00	8.00	1.00	3.00	3.00	1.00	6.00	6.00
Cost	1.00	6.00	6.00	1.00	10.00	10.00	1.00	4.00	4.00	1.00	4.00	4.00
Total Rank[b] Score			20.5			30.5			18.0			24.5

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

Table F6-9. Quantitative Comparison of Evaluation Criteria for 100 B/C Buried Pipelines.*

CERCLA Evaluation Criteria	Remedial Alternatives											
	Containment			Removal/Disposal			In Situ Grouting			Removal/Treatment/Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	2.00	2.00	1.00	7.00	7.00	1.00	3.00	3.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	1.00	0.50	0.50	3.00	1.50	0.50	2.00	1.0	0.50	5.00	2.5
Short-term Effectiveness	0.50	7.00	3.50	0.50	6.00	3.00	0.50	6.00	3.00	0.50	4.00	2.00
Implementability	1.00	3.00	3.00	1.00	7.00	7.00	1.00	2.00	2.00	1.00	5.00	5.00
Cost	1.00	2.00	2.00	1.00	3.00	3.00	1.00	10.00	10.00	1.00	2.00	2.00
Total Rank[b]			11.0			21.5			19.0			20.5

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings
*Buried pipelines include both sludge and soil.

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Table F6-10. Quantitative Comparison of Evaluation Criteria for 118-B-10 Burial Ground.

CERCLA Evaluation Criteria	Remedial Alternatives											
	Containment			Removal/Disposal			In Situ Compaction			Removal/Treatment/Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	3.00	3.00	1.00	7.00	7.00	1.00	4.00	4.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	2.00	1.0	0.50	3.00	1.5	0.50	2.00	1.0	0.50	5.00	2.5
Short-term Effectiveness	0.50	9.00	4.50	0.50	3.00	1.50	0.50	7.00	3.50	0.50	2.00	1.00
Implementability	1.00	5.00	5.00	1.00	5.00	5.00	1.00	4.00	4.00	1.00	3.00	3.00
Cost	1.00	9.00	9.00	1.00	10.00	10.00	1.00	8.00	8.00	1.00	7.00	7.00
Total Rank[b]			22.5			25.0			20.5			22.5

Table F6-11. Quantitative Comparison of Evaluation Criteria for 118-B-7 Burial Ground.

CERCLA Evaluation Criteria	Remedial Alternatives											
	Containment			Removal/Disposal			In Situ Compaction			Removal/Treatment/Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	3.00	3.00	1.00	7.00	7.00	1.00	4.00	4.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	2.00	1.0	0.50	3.00	1.5	0.50	2.00	1.0	0.50	5.00	2.5
Short-term Effectiveness	0.50	9.00	4.50	0.50	3.00	1.50	0.50	7.00	3.50	0.50	2.00	1.00
Implementability	1.00	5.00	5.00	1.00	5.00	5.00	1.00	4.00	4.00	1.00	3.00	3.00
Cost	1.00	4.00	4.00	1.00	10.00	10.00	1.00	3.00	3.00	1.00	3.00	3.00
Total Rank[b]			17.5			25.0			15.5			18.5

Table F6-12. Quantitative Comparison of Evaluation Criteria for 118-B-5 Burial Ground.

CERCLA Evaluation Criteria	Remedial Alternatives											
	Containment			Removal/Disposal			In Situ Compaction			Removal/Treatment/Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	3.00	3.00	1.00	7.00	7.00	1.00	4.00	4.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	2.00	1.0	0.50	3.00	1.5	0.50	2.00	1.0	0.50	5.00	2.5
Short-term Effectiveness	0.50	9.00	4.50	0.50	3.00	1.50	0.50	7.00	3.50	0.50	2.00	1.00
Implementability	1.00	5.00	5.00	1.00	5.00	5.00	1.00	4.00	4.00	1.00	3.00	3.00
Cost	1.00	10.00	10.00	1.00	8.00	8.00	1.00	9.00	9.00	1.00	7.00	7.00
Total Rank[b]			23.5			23.0			21.5			22.5

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

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7.0 COMPARATIVE ANALYSIS FOR NEW REMEDIATION CONCEPT

As discussed in the Introduction of this Appendix, the detailed and comparative analyses performed in Sections 5.0 and 6.0 of the Process Document and this FFS Appendix were based on meeting human health risk-based goals assuming occasional use of the land and soil remediation to support frequent use of groundwater. This scenario is referred to as the baseline scenario. Based on the recent Tri-Party Agreement decision to use Washington's MTCA B regulations and EPA's proposed 15 mrem/yr radiation exposure criteria to establish soil remediation goals, an assessment was conducted to see how this change in cleanup goals effects the analysis of alternatives. The revised frequent use scenario (MTCA B/15 mrem/yr), discussed in the Sensitivity Analysis (Appendix D, Attachment 6), indicates that the revised frequent use scenario imposes two significant changes on the comparative analysis of alternatives. These are:

1. The In Situ and Containment Alternatives are no longer appropriate for interim actions at the 100 Areas because these alternatives leave wastes at the site and thereby preclude several potential future uses. Interim actions, based on the recent Triparty decision, should be consistent with both frequent and occasional use of the land.

2. The revised frequent use scenario potentially requires less excavation than the baseline scenario. Therefore, the costs of the Removal/Disposal and Removal/Treatment/Disposal alternatives are reduced 32 and 30%, respectively, as compared to the baseline scenario. The baseline scenario costs are presented in Appendix B of the Process Document, and the costs and volumes for the revised frequent use scenario are presented in the Sensitivity Analysis (Appendix D).

With the elimination of the Containment and In Situ Treatment alternatives, the Removal/Disposal and Removal/Treatment/Disposal Alternatives become the two principal remedial alternatives. The change from the baseline scenario to the revised frequent use scenario influences these two alternatives in similar ways. Therefore, there is very little effect on the key discriminators used for the comparative analysis. This means that the comparative analysis of these two alternatives under the baseline scenario changes only slightly following the switch to the revised frequent use scenario. The next two subsections evaluate how the revised frequent use scenario changes the results of the original analysis of alternatives. The evaluation is based on information presented in Appendix D, the Process Document, and earlier sections of this FFS Appendix.

7.1 INFLUENCE OF THE REVISED FREQUENT USE CLEANUP GOALS ON THE 100-BC-1 FFS

The development of the remedial alternatives in the 100 Area Feasibility Study Phases 1 and 2 (DOE-RL 1993a) and the Process Document are not influenced by the change in cleanup goals, so the number and types of remedial alternatives stay the same. Likewise, the plug-in approach is still directly applicable for either the baseline or the revised frequent-use scenarios.

The detailed analysis of the Removal/Disposal and Removal/Treatment/Disposal alternatives in the Process Document (Section 5.0) is influenced only slightly by the change in cleanup goals (less excavation is required by the revised frequent use scenario); therefore, there is no change in the assessment of these alternatives with regards to the CERCLA evaluation criteria and NEPA issues. The potential adverse effects of the Removal/Disposal and Removal/Treatment/Disposal alternatives on workers, future site uses, and the environment are also much the same under the revised frequent use scenario as they are under the baseline scenario. Therefore, the detailed analysis of alternatives in the Process Document and this 100-BC-1 FFS Appendix remain valid.

The comparative analysis in Section 6.0 of this FFS Appendix (see Tables F6-1 through F6-12) requires changes because: 1) the In Situ and Containment alternatives drop out and, 2) the ranking based on costs must be recalculated. In most cases the recalculation of costs did not change the relative ranking of the alternatives. That is, the alternative with the highest total rank under the baseline scenario also generally received the highest rank under the revised frequent use scenario. The following subsection describes how the results of the comparative analysis change, in comparison to the results in Section 6.0 of the Process Document and this FFS Appendix, due to the change in the cleanup goals.

7.2 REVISED FREQUENT USE SCENARIO QUANTITATIVE COMPARISON OF REMEDIAL ALTERNATIVES

7.2.1 116-C-5 and 116-B-11 Retention Basins

The Removal/Disposal and Removal/Treatment/Disposal Alternatives are the only alternatives applicable to these retention basins. The scoring and ranking as applied in the Process Document and in this FFS Appendix are still valid, except for costs. The cost reduction of 32 and 30% for Removal/Disposal and Removal/Treatment/Disposal, respectively, changes the score of the 116-C-5 cost category to 10 and 7, respectively. The reduction in excavation does not change the relative advantages and disadvantages of the alternatives. The comparative analysis tables, based on the new remediation concept for 116-C-5, are given in Table F7-1 and for 116-B-11 are given in Table F7-2.

7.2.2 116-C-1 and 116-B-1 Process Effluent Trenches

With the elimination of ISV as an alternative for the 116-C-1 and 116-B-1 process effluent trenches, now only the Removal/Disposal and Removal/Treatment/Disposal Alternatives are applicable to these waste sites. The scoring and ranking as applied in the Process Document and Section 6.0 of this FFS, are still valid except for cost. The cost reduction of 32 and 30% for Removal/Disposal and Removal/Treatment/Disposal, respectively, resulted in no changes to the score of the cost category. The results are provided in Tables F7-3 and F7-4.

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7.2.3 116-B-13 and 116-B-14 Sludge Trenches

With the elimination of ISV, the 116-B-13 and 116-B-14 sludge trenches were evaluated only for Removal/Disposal and Removal/Treatment/Disposal. The scoring and ranking, as applied in the Process Document and Section 6.0 of this FFS, are still valid. The cost reduction factors discussed above resulted in no changes to the score of the cost category. The overall ranking of alternatives is provided in Tables F7-5 and F7-6.

7.2.4 116-B-4 French Drain

With the elimination of the ISV and Containment Alternatives, the Removal/Disposal and Removal/Treatment/Disposal Alternatives are the only alternatives applicable to the 116-B-4 French Drain. The scoring and ranking as applied in the Process Document and in this FFS Appendix are still valid except for costs. The cost reduction of 32% and 30% for Removal/Disposal and Removal/Treatment/Disposal, respectively, resulted in no changes to the score of the cost category. The reduction in excavation does not change the relative advantages and disadvantages of the alternatives. The comparative analysis table, based on the new remediation concept for 116-B-4, is given in Table F7-7.

7.2.5 116-B-5 Special Crib

With the elimination of ISV and containment as an alternative for the 116-B-5 special crib, now only the Removal/Disposal and Removal/Treatment/Disposal Alternatives are applicable to this waste site. The scoring and ranking as applied in the Process Document and Section 6.0 of this FFS, are still valid except for cost. The cost reduction of 32% and 30% for Removal/Disposal and Removal/Treatment/Disposal, respectively, changes the score of the cost category to 10 and 7, respectively. The results are provided in Table F7-8.

7.2.6 100-B/C Buried Pipelines

With the elimination of the ISV and Containment Alternatives for the 100 B/C Buried Pipelines, Removal/Disposal and Removal/Treatment/Disposal are the only viable alternatives to be considered. The scoring and ranking, as applied in the Process Document and Section 6.0 of this FFS, are still valid except for cost. The cost reduction factors discussed above for Removal/Disposal and Removal/Treatment/Disposal changes the score of the cost categories to 10 and 8, respectively. The results are provided in Table F7-9.

7.2.7 100-BC Burial Grounds

With the elimination of ISV and containment, Removal/Disposal and Removal/Treatment/Disposal are the only alternatives to be considered. The scoring and ranking, as applied in the Process Document and Section 6.0 of this FFS, are still valid except for cost, where the 118-B-10 Burial Bround cost score changed to a 10 and a 7 for Removal/Disposal and Removal/Treatment/Disposal, respectively. The results for the comparison of alternatives for the 118-B-10, 118-B-7, and 118-B-5 burial grounds are shown in Tables F7-10, F7-11, and F7-12.

7.2.8 Comparative Analysis Summary

Remedial alternatives were evaluated for cleaning up 12 interim remedial measure candidate sites in the 100-BC-1 Operable Unit. Removal/Disposal and Removal/Treatment/Disposal were the two alternatives evaluated for each IRM candidate site. The comparative analysis indicates that Removal/Disposal may be the most appropriate remedial action at each site.

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Table F7-1. New Remediation Concept Quantitative Comparison of Evaluation Criteria for 116-C-5 Retention Basin.

CERCLA Evaluation Criteria	Remedial Alternatives					
	Removal/Disposal			Removal/Treatment/Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	7.00	7.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	4.00	2.00	0.50	5.00	2.5
Short-term Effectiveness	0.50	6.00	3.00	0.50	3.00	1.50
Implementability	1.00	9.00	9.00	1.00	5.00	5.00
Cost	1.00	10.00	10.00	1.00	7.00	7.00
Total Rank[b]			31.0			25

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

Table F7-2. New Remediation Concept Quantitative Comparison of Evaluation Criteria for 116-B-11 Retention Basin.

CERCLA Evaluation Criteria	Remedial Alternatives					
	Removal/Disposal			Removal/Treatment/Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	7.00	7.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	4.00	2.00	0.50	5.00	2.5
Short-term Effectiveness	0.50	6.00	3.00	0.50	3.00	1.50
Implementability	1.00	9.00	9.00	1.00	5.00	5.00
Cost	1.00	10.00	10.00	1.00	8.00	8.00
Total Rank[b]			31.0			26.0

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

Table F7-3. New Remediation Concept Quantitative Comparison of Evaluation Criteria for 116-C-1 Process Effluent Trench.

CERCLA Evaluation Criteria	Remedial Alternatives					
	Removal/Disposal			Removal/Treatment/ Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	7.00	7.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	3.00	1.5	0.50	5.00	2.5
Short-term Effectiveness	0.50	7.00	3.50	0.50	3.00	1.50
Implementability	1.00	7.00	7.00	1.00	5.00	5.00
Cost	1.00	10.00	10.00	1.00	9.00	9.00
Total Rank[b]			29.0			27.0

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

Table F7-4. New Remediation Concept Quantitative Comparison of Evaluation Criteria for 116-B-1 Process Effluent Trench.

CERCLA Evaluation Criteria	Remedial Alternatives					
	Removal/Disposal			Removal/Treatment/ Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	7.00	7.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	3.00	1.5	0.50	5.00	2.5
Short-term Effectiveness	0.50	7.00	3.50	0.50	3.00	1.50
Implementability	1.00	7.00	7.00	1.00	5.00	5.00
Cost	1.00	10.00	10.00	1.00	8.00	8.00
Total Rank[b]			29.0			26.0

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

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Table F7-5. New Remediation Concept Quantitative Comparison of Evaluation Criteria for 116-B-13 Sludge Trench.

CERCLA Evaluation Criteria	Remedial Alternatives					
	Removal/Disposal			Removal/Treatment/ Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	7.00	7.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	3.00	1.5	0.50	5.00	2.5
Short-term Effectiveness	0.50	7.00	3.50	0.50	5.00	2.50
Implementability	1.00	7.00	7.00	1.00	5.00	5.00
Cost	1.00	10.00	10.00	1.00	6.00	6.00
Total Rank[b]			29.0			25.0

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

Table F7-6. New Remediation Concept Quantitative Comparison of Evaluation Criteria for 116-B-14 Sludge Trench.

CERCLA Evaluation Criteria	Remedial Alternatives					
	Removal/Disposal			Removal/Treatment/Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	7.00	7.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	3.00	1.5	0.50	5.00	2.5
Short-term Effectiveness	0.50	7.00	3.50	0.50	5.00	2.50
Implementability	1.00	7.00	7.00	1.00	5.00	5.00
Cost	1.00	10.00	10.00	1.00	6.00	6.00
Total Rank[b]			29.0			25.0

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

Table F7-7. New Remediation Concept Quantitative Comparison of Evaluation Criteria for 116-B-4 French Drain.

CERCLA Evaluation Criteria	Removal/Disposal			Removal/Treatment/Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	7.00	7.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	3.00	1.5	0.50	5.00	2.50
Short-term Effectiveness	0.50	8.00	4.00	0.50	6.00	3.00
Implementability	1.00	8.00	8.00	1.00	6.00	6.00
Cost	1.00	10.00	10.00	1.00	4.00	4.00
Total Rank[b] Score			30.5			24.5

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

Table F7-8. New Remediation Concept Quantitative Comparison of Evaluation Criteria for 116-B-5 (Special Crib).

CERCLA Evaluation Criteria	Removal/Disposal			Removal/Treatment/Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	7.00	7.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	3.00	1.5	0.50	5.00	2.50
Short-term Effectiveness	0.50	8.00	4.00	0.50	6.00	3.00
Implementability	1.00	8.00	8.00	1.00	6.00	6.00
Cost	1.00	10.00	10.00	1.00	7.00	7.00
Total Rank[b] Score			30.5			27.5

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

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Table F7-9. New Remediation Concept Quantitative Comparison of Evaluation Criteria for 100 B/C Buried Pipelines.

CERCLA Evaluation Criteria	Remedial Alternatives					
	Removal/Disposal			Removal/Treatment/Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	7.00	7.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	3.00	1.50	0.50	5.00	2.5
Short-term Effectiveness	0.50	6.00	3.00	0.50	4.00	2.00
Implementability	1.00	7.00	7.00	1.00	5.00	5.00
Cost	1.00	10.00	10.00	1.00	8.00	8.00
Total Rank[b]			28.5			26.5

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

Table F7-10. New Remediation Concept Quantitative Comparison of Evaluation Criteria for 118-B-10 Burial Grounds.

CERCLA Evaluation Criteria	Remedial Alternatives					
	Removal/Disposal			Removal/Treatment/Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	7.00	7.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	3.00	1.5	0.50	5.00	2.5
Short-term Effectiveness	0.50	3.00	1.50	0.50	2.00	1.00
Implementability	1.00	5.00	5.00	1.00	3.00	3.00
Cost	1.00	10.00	10.00	1.00	7.00	7.00
Total Rank[b]			25.0			22.5

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

Table F7-11. New Remediation Concept Quantitative Comparison of Evaluation Criteria for 118-B-7 Burial Grounds.

CERCLA Evaluation Criteria						
	Removal/Disposal			**Removal/Treatment/Disposal**		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	7.00	7.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	3.00	1.5	0.50	5.00	2.5
Short-term Effectiveness	0.50	3.00	1.50	0.50	2.00	1.00
Implementability	1.00	5.00	5.00	1.00	3.00	3.00
Cost	1.00	10.00	10.00	1.00	9.00	3.00
Total Rank[b]			25.0			18.5

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

Table F7-12. New Remediation Concept Quantitative Comparison of Evaluation Criteria for 118-B-5 Burial Ground.

CERCLA Evaluation Criteria	**Remedial Alternatives**					
	Removal/Disposal			**Removal/Treatment/Disposal**		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	7.00	7.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	3.00	1.5	0.50	5.00	2.5
Short-term Effectiveness	0.50	3.00	1.50	0.50	2.00	1.00
Implementability	1.00	5.00	5.00	1.00	3.00	3.00
Cost	1.00	10.00	8.00	1.00	9.00	7.00
Total Rank[b]			23.0			22.5

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

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ATTACHMENT 1

100-BC-1 OPERABLE UNIT WASTE SITE VOLUME ESTIMATES

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Volume Estimate
100-BC-1 Operable Unit

OBJECTIVE:

Provide estimates of:

- The volume of contaminated materials within high priority waste sites in the 100-BC-1 Operable Unit.
- The volume of materials that will need to be excavated to remove the contaminated materials.
- The areal extent of contamination.

Estimates are provided for the following waste sites:

Site Number	Site Name	Page
116-B-1	107-B Liquid Waste Disposal Trench	FA1-7
116-B-5	108-B Crib	FA1-8
116-C-5	107-C Retention Basin	FA1-11
116-C-1	107-C Liquid Waste Disposal Trench	FA1-13
116-B-11	107-B Retention Basin	FA1-15
116-B-13	107-B South Sludge Trench	FA1-17
116-B-14	107-B North Sludge Trench	FA1-19
116-B-4	105-B Dummy Decon French Drain	FA1-21
116-B-12	117-B Crib	FA1-23
132-B-4	117-B Filter Building	FA1-24
132-B-5	115-B/C Gas Recirculation Building	FA1-25
118-B-5	Ball 3X Burial Ground	FA1-26
118-B-7	111-B Solid Waste Burial Ground	FA1-28
118-B-10	Pit/Burial Ground	FA1-30
Pipelines	Effluent Pipelines (soil and sludge)	FA1-32
Pipelines	Pipeline Leak at B/C Junction Box	FA1-33

Volume Estimate
100-BC-1 Operable Unit

METHOD:

The following steps are used to calculate volumes and areas for each waste site:

- Estimate the dimensions of each waste site.
- Estimate the location of the site.
- Estimate the extent of contamination present at each site.
- Estimate the extent of the excavation necessary to remove the contamination present.
- Calculate the volume of contamination present, the volume of material to be removed, and the areal extent of contamination.

Waste Site Dimensions -
Dimensions of the waste site are derived from all pertinent references. The reference used is noted in brackets [].

Waste Site Location -
Location of the waste site is derived from pertinent references confirmed by field visit. The specific reference or method used to locate each site is discussed in a separate brief [7]. Coordinates for each waste site are converted to Washington State coordinates [8]. Resulting Washington State coordinates are presented herein.

Contaminated Volume Dimensions -
The extent of contamination present at the waste site is estimated from analytical data that exists for the site (References 5 and 6). The data used, assumptions made, and method for estimating extent is discussed in a separate brief [9]. Dimensions are summarized herein.

Excavated Volume Dimensions -
The extent of the excavation necessary to remove the contamination is based on a 1.5 H : 1.0 V excavation slope with the extent of contamination at depth serving as the bottom of the excavation.

Volume and Area Calculations -
The above information is used to construct a digital terrain model of each site within the computer program AutoCad. The computer program DCA is then used to calculate volumes and areas for the waste site.

ASSUMPTIONS:

The following assumptions were used to locate and/or provide dimensions for a waste site if no other data exists. See Reference 9 for assumptions concerning extent of contamination and Reference 7 for assumptions concerning location of the waste site.

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Volume Estimate
100-BC-1 Operable Unit

ASSUMPTIONS (continued):

Burial Grounds -
- Burial ground dimensions are 6.10 m (20 ft) wide at the bottom, 6.10 m (20 ft) deep, and have 1.0 H : 1.0 V side slopes.
- Five feet of additional cover was provided.
- Burial grounds were completely filled.

Liquid Waste Sites -
- Trenches were built with 1.0 H : 1.0 V side slopes.
- Tops of cribs are 1.8 m (6 ft) below grade.

The following assumptions were used in calculating volumes and areas:
- No site interferences or overlaps are considered, volumes and areas are calculated for each waste site separately.
- 1.5 H: 1.0 V side slopes assumed for excavation.

All depths are below grade unless noted.

REFERENCES:

1 DOE-RL, 1991, *Hanford Site Waste Information Data System* (WIDS), U.S. Department of Energy, Richland Operations Office,Richland, Washington.

2. Hanford Site Drawings and Plans.

3. Site topographic maps, Drawings H-13-000100 to H-13-000106.

4. Historical photographs of the 100-B/C Area.

5. Dorian, J. J. and V. R. Richards, 1978, *Radiological Characterization of the Retired 100 Areas*, UNI-946, United Nuclear Industries, Richland, Washington.

6. DOE-RL, 1993, *Limited Field Investigations Report for the 100-BC-1 Operable Unit*, DOE-RL-93-06, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

7. DOE-RL, 1993, *Limited Field Investigations Report for the 100-BC-5 Operable Unit*, DOE-RL-93-97, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

8. IT Corporation, 1993, "100-B/C Waste Site Locations," IT Corporation Calculation Brief, Project Number 199806.317.

Volume Estimate
100-BC-1 Operable Unit

REFERENCES (continued):

9. IT Corporation, 1993, "100-B/C Area Volume Estimate," IT Corporation Calculation Brief, Project Number 199806.317.

10. IT Corporation, 1993, "100-BC-1 Waste Site Contaminated Extent," IT Corporation Calculation Brief, Project Number 199806.407.

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Volume Estimate
100-BC-1 Operable Unit

SITE NUMBER: 116-B-1
SITE NAME: 107-B Liquid Waste Disposal Trench

WASTE SITE DIMENSIONS:

Length - 114.3 m (375 ft) along top, 108.2 m (355 ft) along bottom [4]
Width - 9.1 m (30 ft) along bottom, 15.2 m (50 ft) at surface [4]
Depth - 4.6 m (15 ft) [1]. Sandy gravel fill extends to a depth of about 6.4 m (21 ft) below grade, 1.8 m (6 ft) below trench bottom [6]
Slopes - 1.0 H : 1.5 V [9]
Orientation - Long axis oriented N 45 E [2]

Waste site has been backfilled to the surface [3]. Backfill is considered uncontaminated.

CONTAMINATED VOLUME DIMENSIONS:

Trench was filled with liquids to an average level of 3 m (10 ft) above base, side slopes and substrate are contaminated to a depth of 5 ft (1.5 m) below the trench bottom) [10]. No lateral contamination extends from the edges of the trench [9].

Length - 112.2 m (368 ft); 2.0 m (6.7 ft) SW and NE from bottom edge of site
Width - 13.1 m (43 ft); 2.0 m (6.7 ft) NW and SE from bottom edge of site
Depth - 6.1 m (20 ft) below grade, 1.5 m (5 ft) below base of trench

EXCAVATED VOLUME DIMENSIONS:

Bottom of excavation is 112.2 m (368 ft) x 13.1 m (43 ft) at a depth of 6.1 m (20 ft) [10]
Excavation Slopes - 1.5 H : 1.0 V
See attached figure for excavation top dimensions.

WASTE SITE LOCATION:

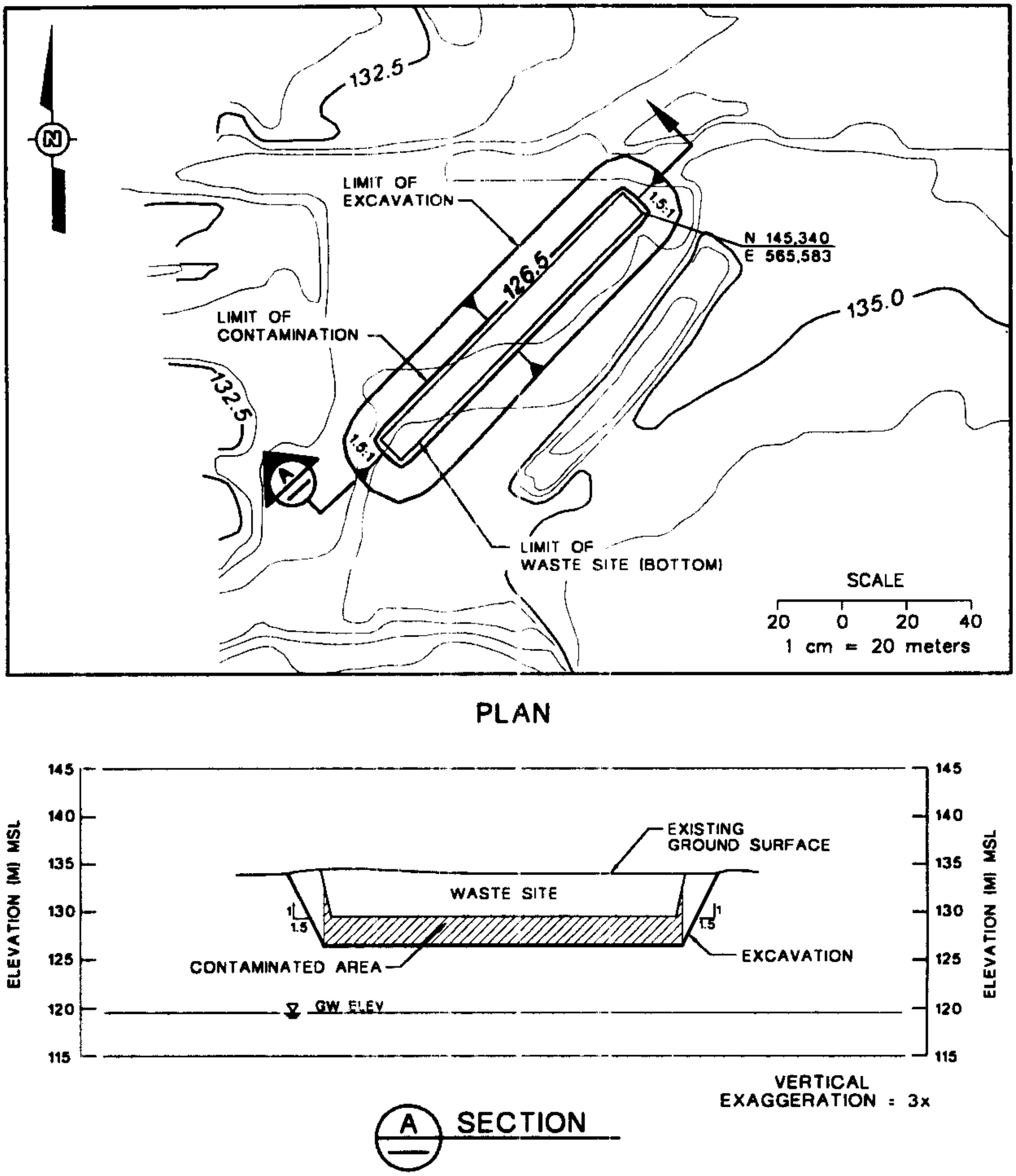
Northing: 145,340
Easting: 565,583

Reference Point: Northeast corner at surface

ELEVATIONS:

Surface: 134.1 m (440 ft) [3]
Groundwater: 119.5 m (392 ft) [7]

Figure FA1-1. IRM Site: 116-B-1.



EXTENT OF CONTAMINATION

SURFACE AREA = 1,470 sq. meters
VOLUME = 6,762 cu. meters

EXTENT OF EXCAVATION

SURFACE AREA = 4,288 sq. meters
VOLUME = 21,592 cu. meters

116B1

DRAFT

Volume Estimate
100-BC-1 Operable Unit

SITE NUMBER: 116-B-5
SITE NAME: 108-B Crib

WASTE SITE DIMENSIONS:

Length - 25.6 m (84 ft) along bottom [1]
Width - 4.9 m (16 ft) along bottom [1]
Depth - 3.5 m (11.5 ft) [6]
Slopes - 1.0 H : 1.0 V
Orientation - Long axis oriented N-S [2]

Waste site contains layers of boiler ash, concrete, void space, and sandy gravel fill [6].

CONTAMINATED VOLUME DIMENSIONS:

Data indicate that contamination has spread to 2.6 m (8.5 ft) below the base of the site [10]. No lateral contamination is assumed to exist beyond top dimensions of site [10].

Length - 29 m (95 ft); 1.7 m (5.5 ft) beyond each end of the bottom of site
Width - 8.2 m (27 ft); 1.7 m (5.5 ft) beyond each side of the bottom of site
Depth - 4.3 m (14 ft); from 1.8 m (6 ft) to 6.1 m (20 ft) below grade

EXCAVATED VOLUME DIMENSIONS:

Bottom of excavation is 29 m (95 ft) x 8.2 m (27 ft) at a depth of 6.1 m (20 ft)
Excavation Slopes - 1.5 H : 1.0 V
See attached figure for excavation top dimensions.

WASTE SITE LOCATION:

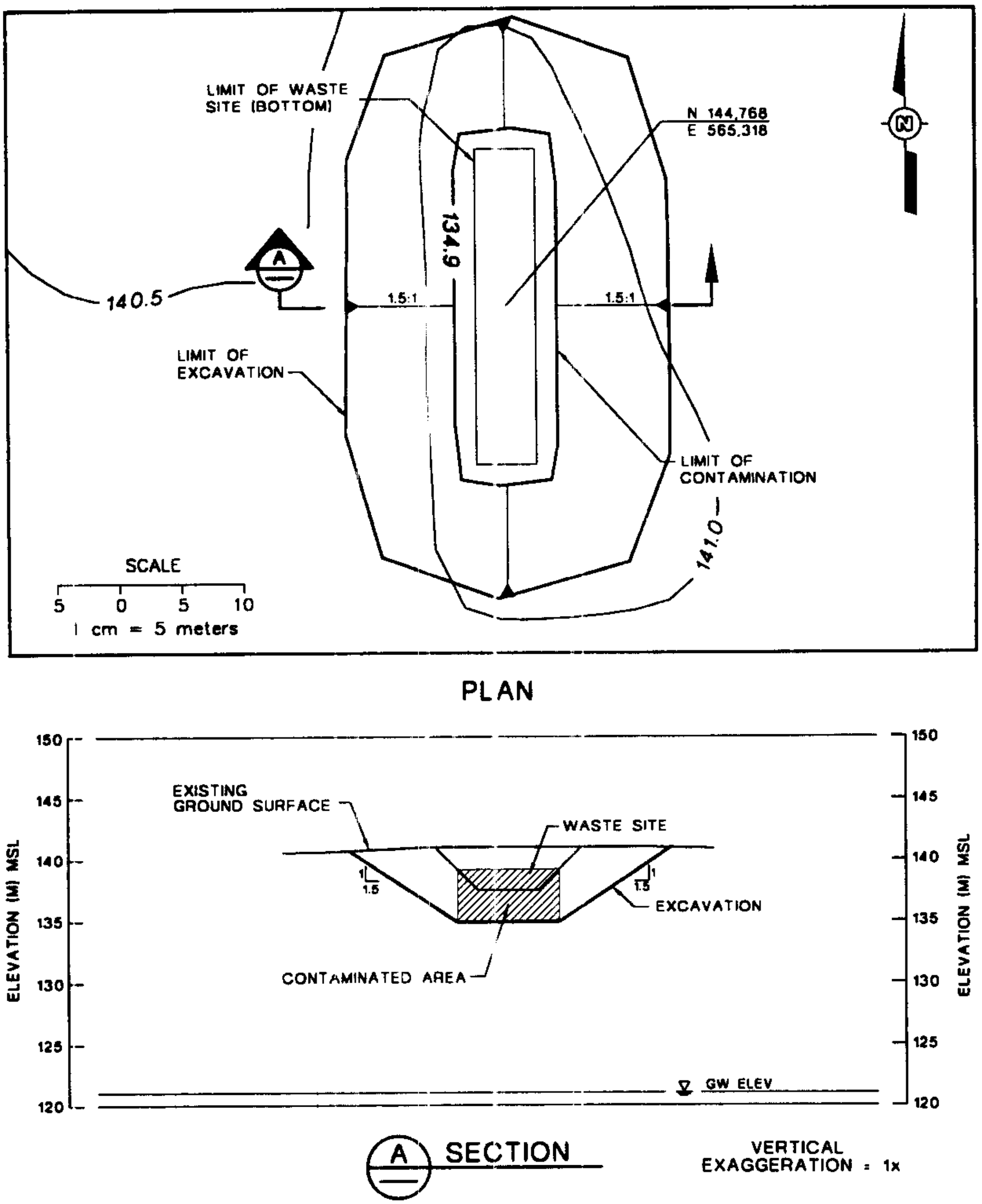
Northing: 144,768
Easting: 565,318

Reference Point: Center of waste site

ELEVATIONS:

Surface: 140.5 m (461 ft) [3]
Groundwater: 121.0 m (397 ft) [7]

Figure FA1-2. IRM Site: 116-B-5.



EXTENT OF CONTAMINATION

SURFACE AREA = 232 sq. meters
VOLUME = 1,022 cu. meters

EXTENT OF EXCAVATION

SURFACE AREA = 1,066 sq. meters
VOLUME = 3,763 cu. meters

116B5

DRAFT

Volume Estimate
100-BC-1 Operable Unit

SITE NUMBER: 116-C-5
SITE NAME: 107-C Retention Basin

WASTE SITE DIMENSIONS:

Diameter - 100.6 m (330 ft) each tank [1]
Depth - Tanks sit on grade, walls are 4.9 m (16 ft) high [1]
Slopes - Vertical walls [2]

Waste site consists of two carbon steel tanks with a series of baffle plates inside. Tanks have been backfilled with 0.9 m (3 ft) of soil [6].

CONTAMINATED VOLUME DIMENSIONS:

Data indicate that contamination has spread laterally up to 12.2 m (40 ft) from the edges of the tank [10].

Diameter - 12.2 m (40 ft) from edge of each tank
Depth - 6.1 m (20 ft) below grade

EXCAVATED VOLUME DIMENSIONS:

Bottom of excavation will be an additional 12.2 m (40 ft) radius around tank at a depth of 6.1 m (20 ft)
Excavation Slopes - 1.5 H : 1.0 V
See attached figure for excavation top dimensions.

WASTE SITE LOCATION:

Northing: 145,110
Easting: 565,390

Reference Point: Center of W tank.

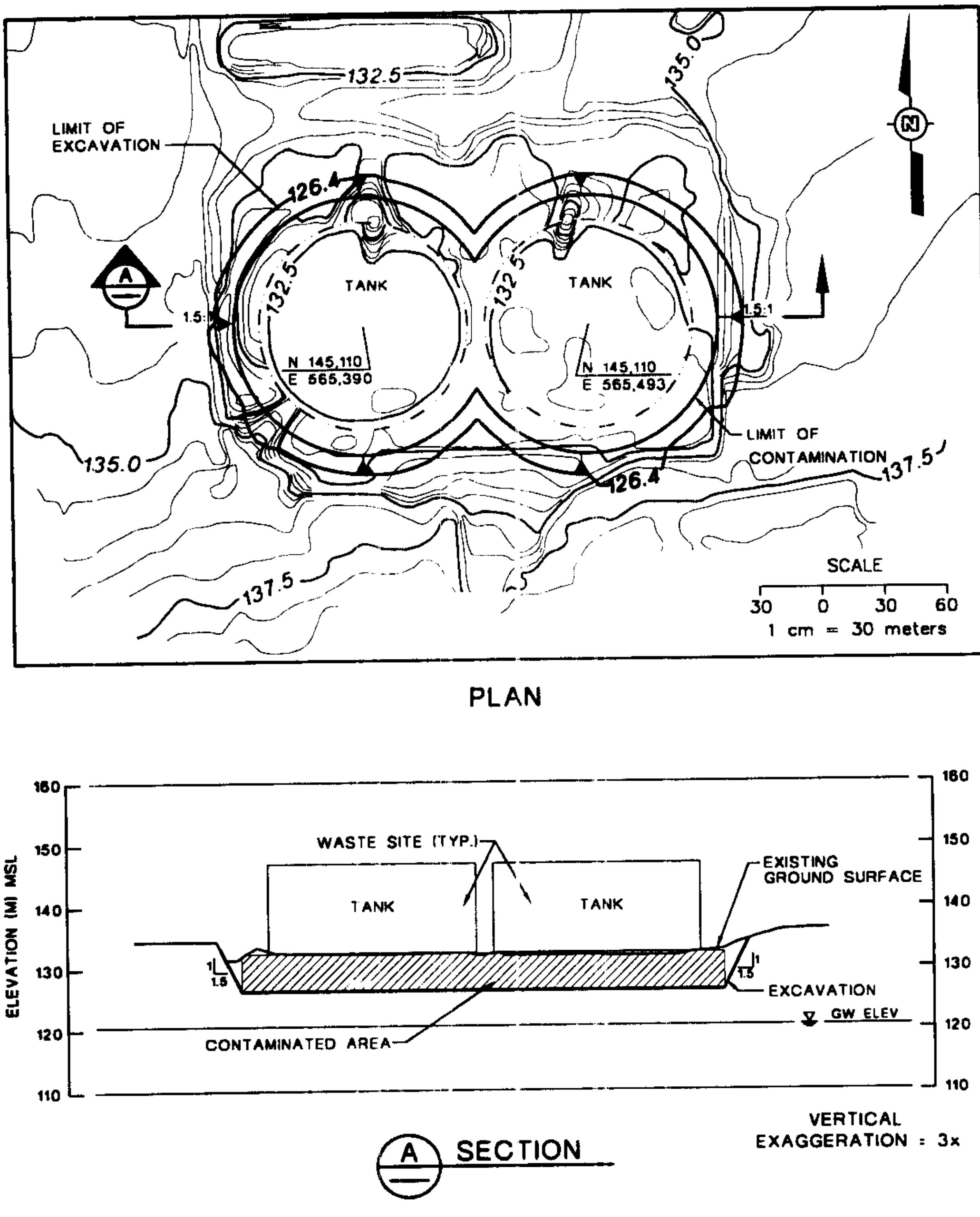
Northing: 145,110
Easting: 565,493

Reference Point: Center of E tank

ELEVATIONS:

Surface: 132.3 m (434 ft) [3]
Groundwater: 120.4 m (395 ft) [7]

Figure FA1-3. IRM Site: 116-C-5.



EXTENT OF CONTAMINATION

SURFACE AREA : 23,805 sq. meters
VOLUME : 145,210 cu. meters

EXTENT OF EXCAVATION

SURFACE AREA : 30,628 sq. meters
VOLUME : 160,667 cu. meters

116C5

DRAFT

Volume Estimate
100-BC-1 Operable Unit

SITE NUMBER: 116-C-1
SITE NAME: 107-C Liquid Waste Disposal Trench

WASTE SITE DIMENSIONS:

Length - 152.4 m (500 ft) along bottom, 175.3 m (575 ft) at surface [1,2]
Width - 15.2 m (50 ft) along bottom, 38.1 m (125 ft) at surface [1,2]
Depth - 7.6 m (25 ft) [1]
Slopes - 1.5 H : 1.0 V [2]
Orientation - Long axis oriented N 75 E [2]

Waste site has been backfilled to the surface [3].

CONTAMINATED VOLUME DIMENSIONS:

Contamination extends from 1.8 m (6 ft) to 7.6 m (25 ft) below grade. Contamination is within the top dimension of the trench.

Length - 169.8 m (557 ft)
Width - 32.6 m (107 ft)
Depth - 5.8 m (19 ft)

EXCAVATED VOLUME DIMENSIONS:

Bottom of excavation is 169.8 m (557 ft) x 32.6 m (107 ft) at a depth of 7.6 m (25 ft)
Excavation Slopes - 1.5 H : 1.0 V
See attached figure for surface dimensions.

WASTE SITE LOCATION:

Northing: 145,363
Easting: 565,794

Reference Point: Center of SW bottom site edge.

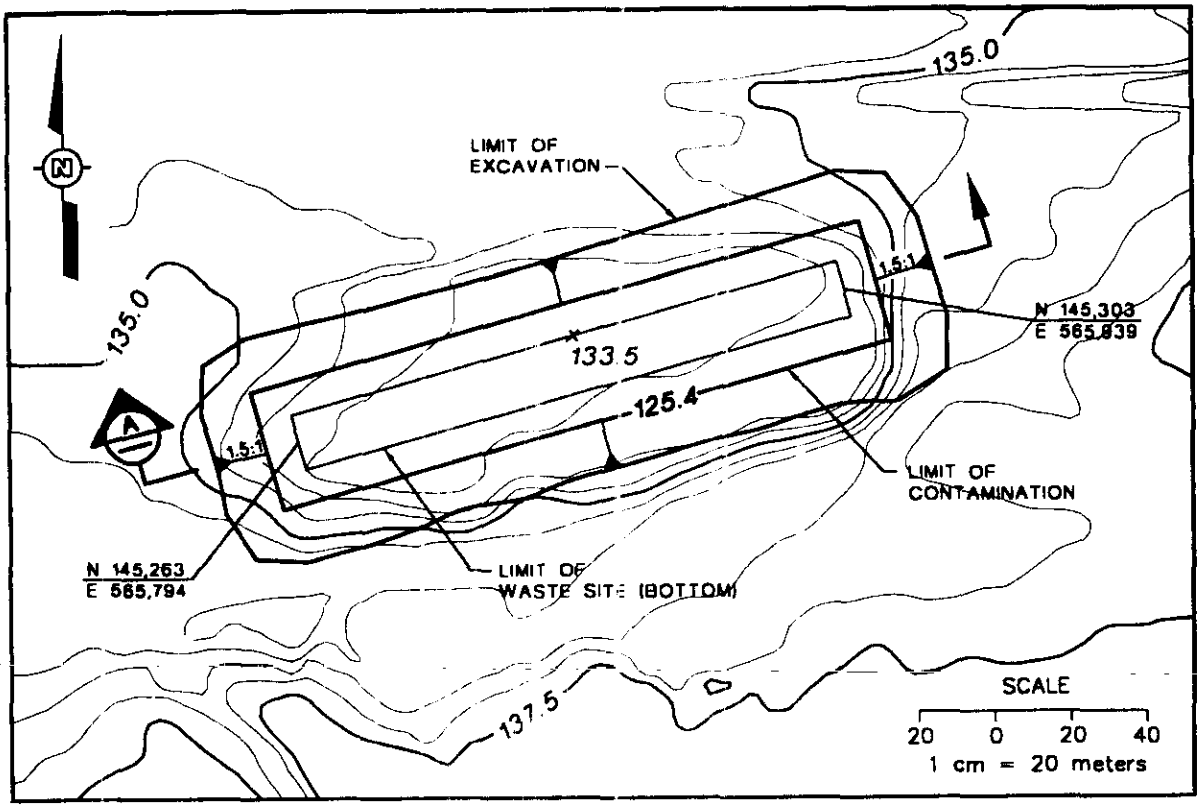
Northing: 145,303
Easting: 565,939

Reference Point: Center of NE bottom site edge

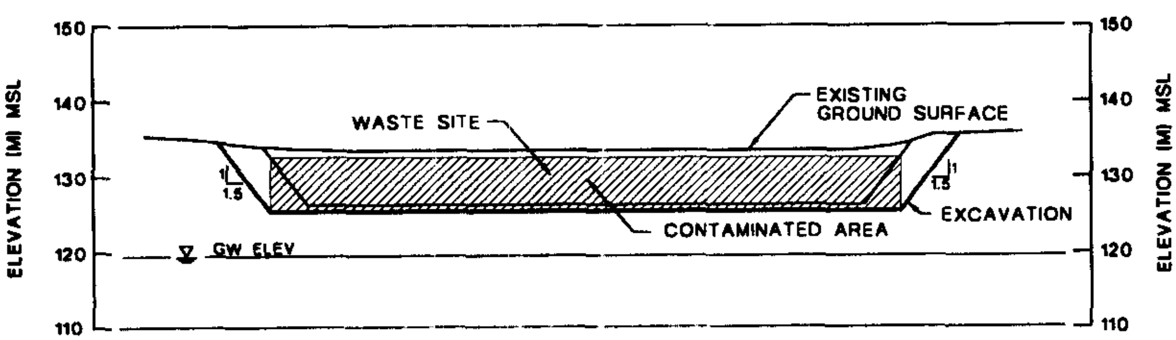
ELEVATIONS:

Surface: 133.2 m (437 ft) [3]
Groundwater: 119.5 m (392 ft) [7]

Figure FA1-4. IRM Site: 116-C-1.



PLAN



A SECTION

VERTICAL EXAGGERATION = 2x

EXTENT OF CONTAMINATION

SURFACE AREA = 5,535 sq. meters
VOLUME = 31,441 cu. meters

EXTENT OF EXCAVATION

SURFACE AREA = 11,475 sq. meters
VOLUME = 69,048 cu. meters

116C1

DRAFT

Volume Estimate
100-BC-1 Operable Unit

SITE NUMBER: 116-B-11
SITE NAME: 107-B Retention Basin

WASTE SITE DIMENSIONS:

Length - 143.3 m (470 ft) [2]
Width - 70.1 m (230 ft) [1,2]
Depth - 1.5 m (5 ft) [5]
Slopes - Vertical [2]
Orientation - Long axis oriented E-W [2]

Waste site has been backfilled with 1.2 m (4 ft) of fill [5]. Backfill is considered contaminated.

CONTAMINATED VOLUME DIMENSIONS:

Data indicate that contamination has spread laterally up to 41.1 m (135 ft) north and 33.5 m (110 ft) east, and west of the site boundaries [10].

Length - 210.3 m (690 ft); 33.5 m (110 ft) from E and W edge of site
Width - 111.3 m (365 ft); 41.1 m (135 ft) N from edge of site
Depth - 6.1 m (20 ft) below grade

EXCAVATED VOLUME DIMENSIONS:

Bottom of excavation is 210.3 m (690 ft) x 111.3 m (365 ft) at a depth of 6.1 m (20 ft) below grade.
Excavation Slopes - 1.5 H : 1.0 V
See attached figure for excavation top dimensions.

WASTE SITE LOCATION:

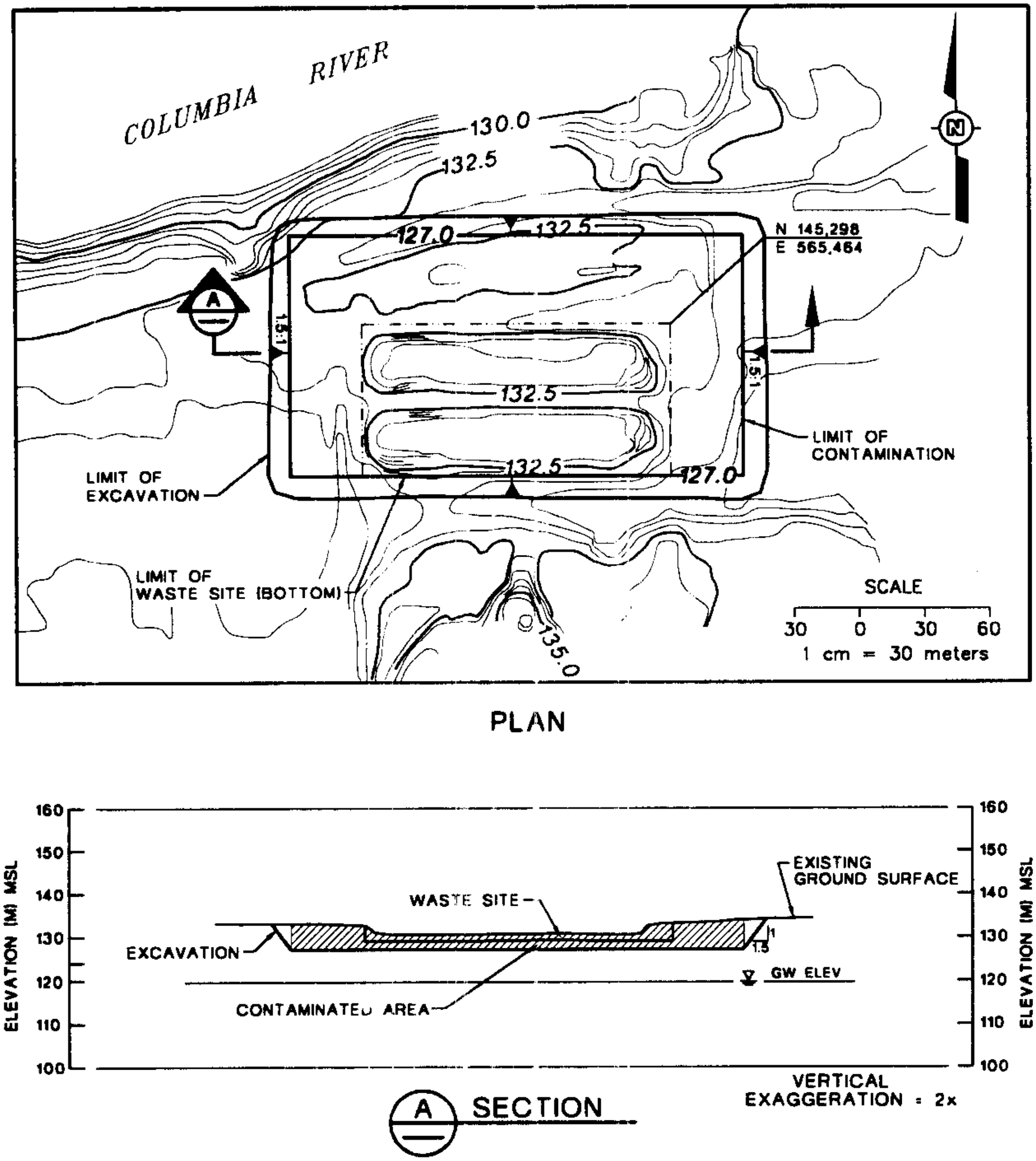
Northing: 145,298
Easting: 565,464

Reference Point: Northeast corner of waste site

ELEVATIONS:

Surface: 130.2 m (427 ft) [3]
Groundwater: 119.5 m (392 ft) [7]

Figure FA1-5. IRM Site: 116-B-11.



EXTENT OF CONTAMINATION

SURFACE AREA : 23,406 sq. meters
VOLUME : 118,835 cu. meters

EXTENT OF EXCAVATION

SURFACE AREA : 29,849 sq. meters
VOLUME : 144,366 cu. meters

116B11

DRAFT

Volume Estimate
100-BC-1 Operable Unit

SITE NUMBER: 116-B-13
SITE NAME: 107-B South Sludge Trench

WASTE SITE DIMENSIONS:

Length - 15.2 m (50 ft) [1]
Width - 15.2 m (50 ft) [1]
Depth - 3.0 m (10 ft) [1]
Slopes - Vertical [2].
Orientation - Oriented N-S [2]

Sludge trench has been covered with 1.8 m (6 ft) of soil [1].

CONTAMINATED VOLUME DIMENSIONS:

It is assumed that contamination has spread to 0.9 m (3 ft) below the base of the site [10]. No lateral contamination is assumed to exist [10].

Length - 15.2 m (50 ft)
Width - 15.2 m (50 ft)
Depth - 4.0 m (13 ft); from 1.8 m (6 ft) to 5.8 m (19 ft) below grade

EXCAVATED VOLUME DIMENSIONS:

Bottom of excavation is 15.2 m (50 ft) x 15.2 m (50 ft) at a depth of 5.8 m (19 ft)
Excavation Slopes - 1.5 H : 1.0 V
See attached figure for excavation top dimensions.

WASTE SITE LOCATION:

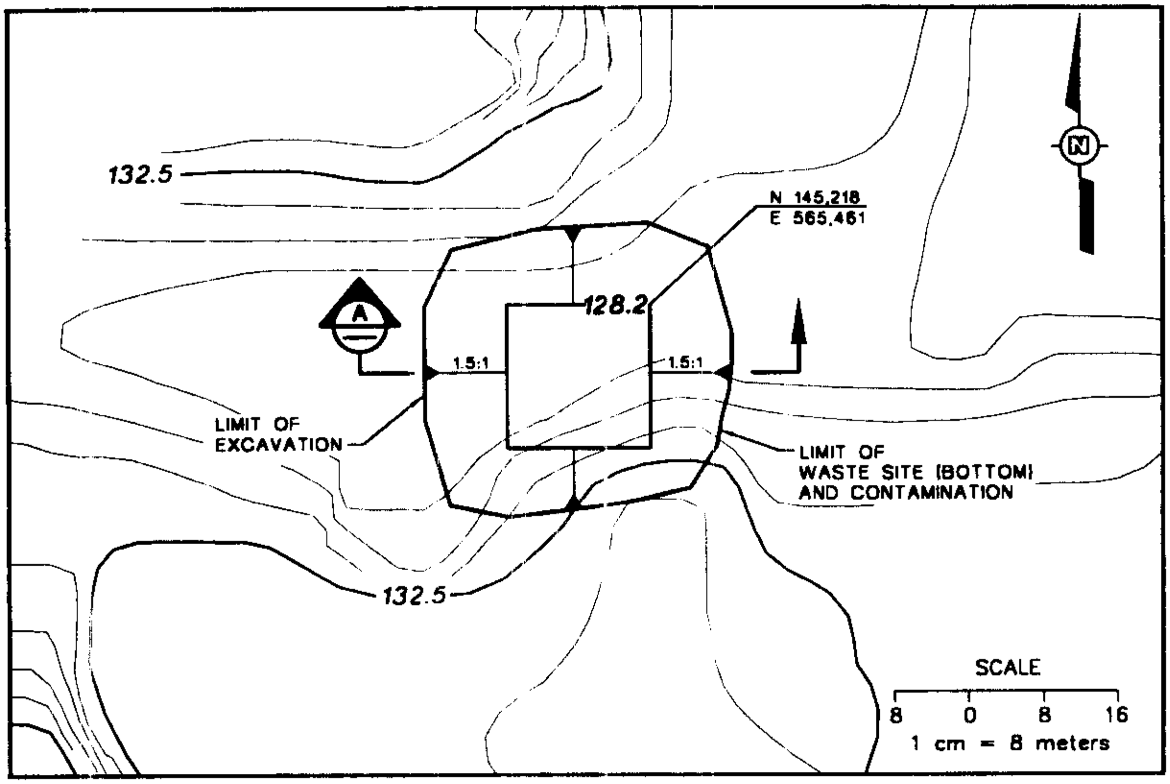
Northing: 145,218
Easting: 565,461

Reference Point: Northeast corner of waste site

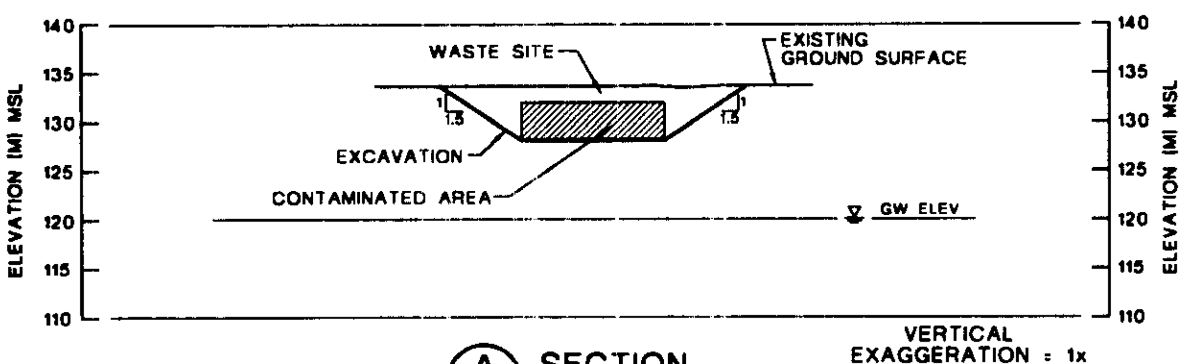
ELEVATIONS:

Surface: 134.1 m (440 ft) [3]
Groundwater: 120.1 m (394 ft) [7]

Figure FA1-6. IRM Site: 116-B-13.



PLAN



A SECTION

EXTENT OF CONTAMINATION

SURFACE AREA = 228 sq. meters
VOLUME = 924 cu. meters

EXTENT OF EXCAVATION

SURFACE AREA = 879 sq. meters
VOLUME = 2,927 cu. meters

116B13

DRAFT

Volume Estimate
100-BC-1 Operable Unit

SITE NUMBER: 116-B-14
SITE NAME: 107-B North Sludge Trench

WASTE SITE DIMENSIONS:

Length - 36.6 m (120 ft) [1]
Width - 3 m (10 ft) [1]
Depth - 3 m (10 ft) [1]
Slopes - Vertical [9]
Orientation - Long axis oriented E-W [2]

Sludge trench has been covered with 1.8 m (6 ft) of soil [1].

CONTAMINATED VOLUME DIMENSIONS:

It is assumed that contamination has spread to 0.9 m (3 ft) below the base of the site [10]. No lateral contamination is assumed to exist [10].

Length - 36.6 m (120 ft)
Width - 3.0 m (10 ft)
Depth - 4.0 m (13 ft) from 1.8 m (6 ft) to 5.8 m (19 ft) below grade

EXCAVATED VOLUME DIMENSIONS:

Bottom of excavation is 36.6 m (120 ft) x 3 m (10 ft) at a depth of 5.8 m (19 ft) below grade
Excavation Slopes - 1.5 H : 1.0 V
See attached figure for excavation top dimensions.

WASTE SITE LOCATION:

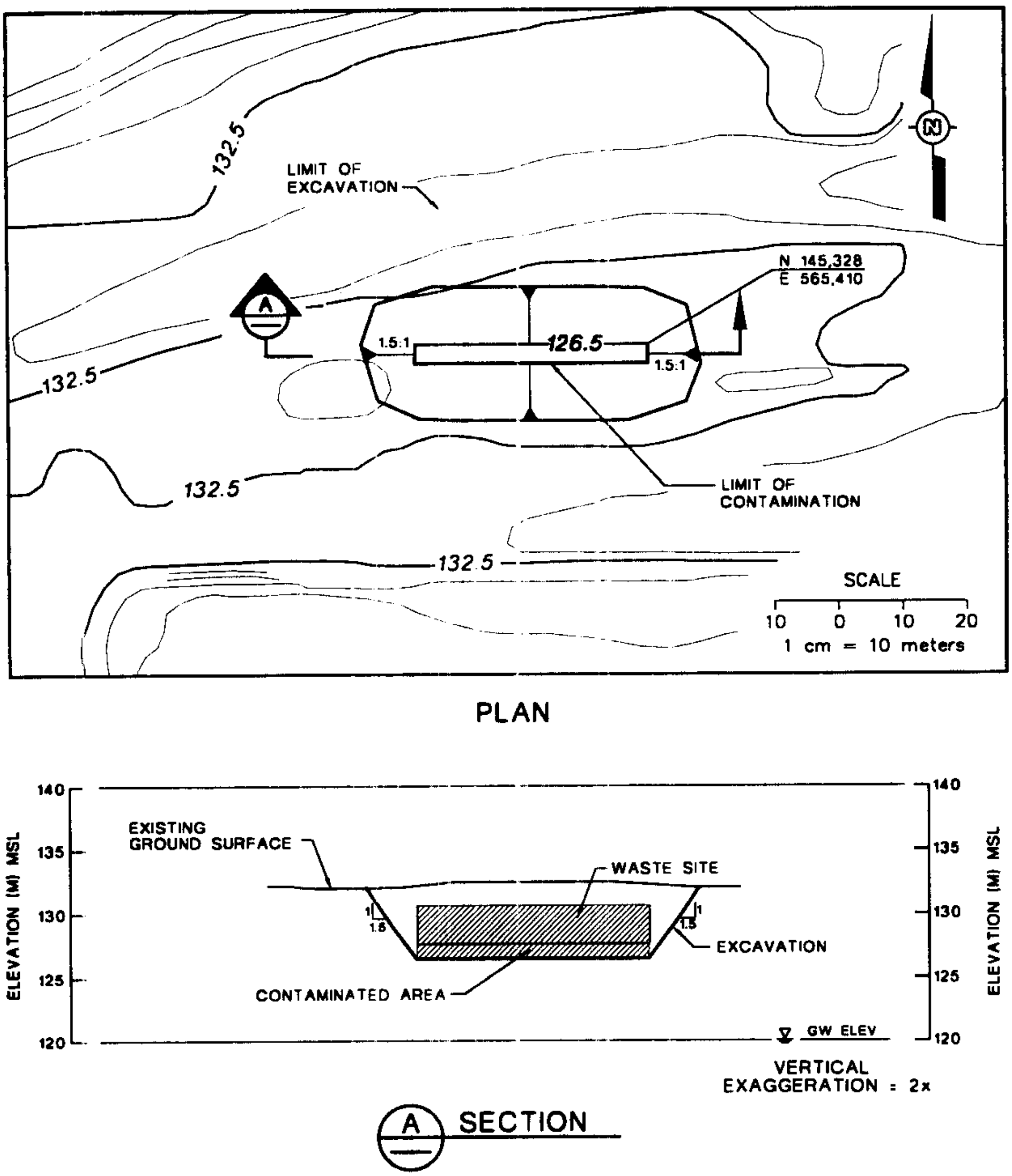
Northing: 145,328
Easting: 565,410

Reference Point: Northeast corner of waste site

ELEVATIONS:

Surface: 134.1 m (440 ft) [3]
Groundwater: 120.1 m (394 ft) [7]

Figure FA1-7. IRM Site: 116-B-14.



EXTENT OF CONTAMINATION

SURFACE AREA = 110 sq. meters
VOLUME = 439 cu. meters

EXTENT OF EXCAVATION

SURFACE AREA = 1,011 sq. meters
VOLUME = 3,106 cu. meters

116B14

DRAFT

Volume Estimate
100-BC-1 Operable Unit

SITE NUMBER: 116-B-4
SITE NAME: 105-B Dummy Decontamination French Drain

WASTE SITE DIMENSIONS:

Diameter - 1.2 m (4 ft) [1]
Depth - 6.1 m (20 ft) [1]
Slopes - Vertical walls [2]

Waste site has a graded rock and sand bottom [1]. The site has been backfilled to the surface [9].

CONTAMINATED VOLUME DIMENSIONS:

It is assumed that contamination is within the confines of the site [10]. No lateral contamination exists [10].

Diameter - 1.2 m (4 ft)
Depth - 2.7 m (9 ft); from 1.8 m (6 ft) to 4.6 m (15 ft) below grade

EXCAVATED VOLUME DIMENSIONS:

Bottom of excavation is 1.2 m (4 ft) in diameter at a depth of 4.6 m (15 ft) below grade
Excavation Slopes - 1.5 H : 1.0 V
See attached figure for excavation top dimensions.

WASTE SITE LOCATION:

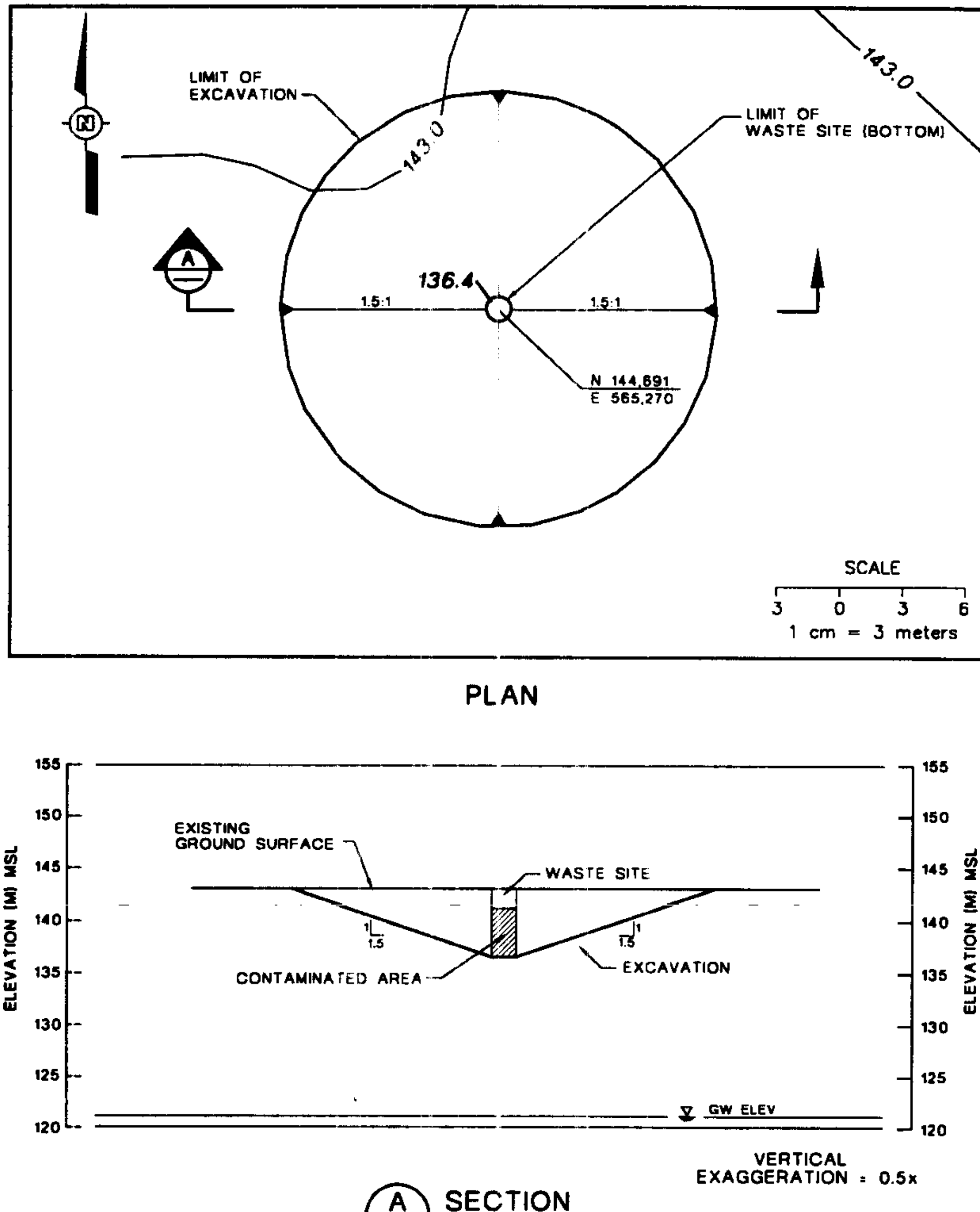
Northing: 144,523
Easting: 565,359

Reference Point: Center of waste site

ELEVATIONS:

Surface: 143.0 m (469 ft) [3]
Groundwater: 121.0 m (397 ft) [7]

Figure FA1-8. IRM Site: 116-B-4.



EXTENT OF CONTAMINATION

SURFACE AREA = 1.12 sq. meters
VOLUME = 3.20 cu. meters

EXTENT OF EXCAVATION

SURFACE AREA = 340 sq. meters
VOLUME = 789 cu. meters

116B4

DRAFT

Volume Estimate
100-BC-1 Operable Unit

SITE NUMBER: 116-B-12
SITE NAME: 117-B Crib

WASTE SITE DIMENSIONS:

Length - 3 m (10 ft) [1]
Width - 3 m (10 ft) [1]
Depth - 3 m (10 ft) [5]
Slopes - Vertical [9]
Orientation - Oriented N-S [2]

The crib was backfilled to grade with soil after use [6]. Top of crib is 1.8 m (6 ft) below land surface.

CONTAMINATED VOLUME DIMENSIONS:

Assume no contaminated volume [10].

EXCAVATED VOLUME DIMENSIONS:

Excavation Slopes - N/A

WASTE SITE LOCATION:

Northing: 144,447
Easting: 565,387

Reference Point: Center of waste site

ELEVATIONS:

Surface: 144.5 m (474 ft) [3]
Groundwater: 121.0 m (397 ft) [7].

Volume Estimate
100-BC-1 Operable Unit

SITE NUMBER: 132-B-4
SITE NAME: 117-B Filter Building

WASTE SITE DIMENSIONS:

Length - 18.0 m (59 ft) [1]
Width - 11.9 m (39 ft) [1]
Depth - 8.2 m (27 ft) [1]
Slopes - Vertical [9]
Orientation - Long axis oriented E-W [2]

The top of the existing structure is 0.9 m (3 ft) below grade and is covered with clean backfill [1].

CONTAMINATED VOLUME DIMENSIONS:

Assume no contaminated volume [10].

EXCAVATED VOLUME DIMENSIONS:

Excavation Slopes - N/A

WASTE SITE LOCATION:

Northing: 144,458
Easting: 565,290

Reference Point: NW corner of waste site

ELEVATIONS:

Surface: 143.9 m (472 ft) [3]
Groundwater: 121.0 m (397 ft) [7]

DRAFT

Volume Estimate
100-BC-1 Operable Unit

SITE NUMBER: 132-B-5
SITE NAME: 115-B/C Gas Recirculation Building

WASTE SITE DIMENSIONS:

Length - 51.2 m (168 ft) [1]
Width - 25.9 m (85 ft) [1]
Depth - 3.4 m (11 ft) [1]
Slopes - Vertical [9]
Orientation - Long axis oriented E-W [2]

The top of the existing structure is 0.9 m (3 ft) below grade and is covered with clean backfill [1].

CONTAMINATED VOLUME DIMENSIONS:

Assume no contaminated volume [10].

EXCAVATED VOLUME DIMENSIONS:

Excavation Slopes - N/A

WASTE SITE LOCATION:

Northing: 144,441
Easting: 565,344

Reference Point: Northeast corner of waste site

ELEVATIONS:

Surface: 143.9 m (472 ft) [3]
Groundwater: 121.0 m (397 ft) [7]

Volume Estimate
100-BC-1 Operable Unit

SITE NUMBER: 118-B-5
SITE NAME: Ball 3X Burial Ground

WASTE SITE DIMENSIONS:

Site is L-shaped with bottom dimensions from the SW corner 22 x 22 x 8 x 14 x 14 x 8.2 m (72 x 72 x 26 x 46 x 46 x 27 ft)
Depth - 6.1 m (20 ft) [1]
Slopes - 1.0 H : 1.0 V [9].
Orientation - Oriented N-S [2]

Waste site has been covered with 1.5 m (5 ft) (mounded) of overburden [1]. Overburden is considered uncontaminated.

CONTAMINATED VOLUME DIMENSIONS:

No contamination extends beyond the limits of the site [9].

Contaminated dimensions are equal to waste site dimensions.

EXCAVATED VOLUME DIMENSIONS:

Excavation Slopes - 1.5 H : 1.0 V
See attached figure for excavation top dimensions.

WASTE SITE LOCATION:

Northing: 145,395
Easting: 565,368

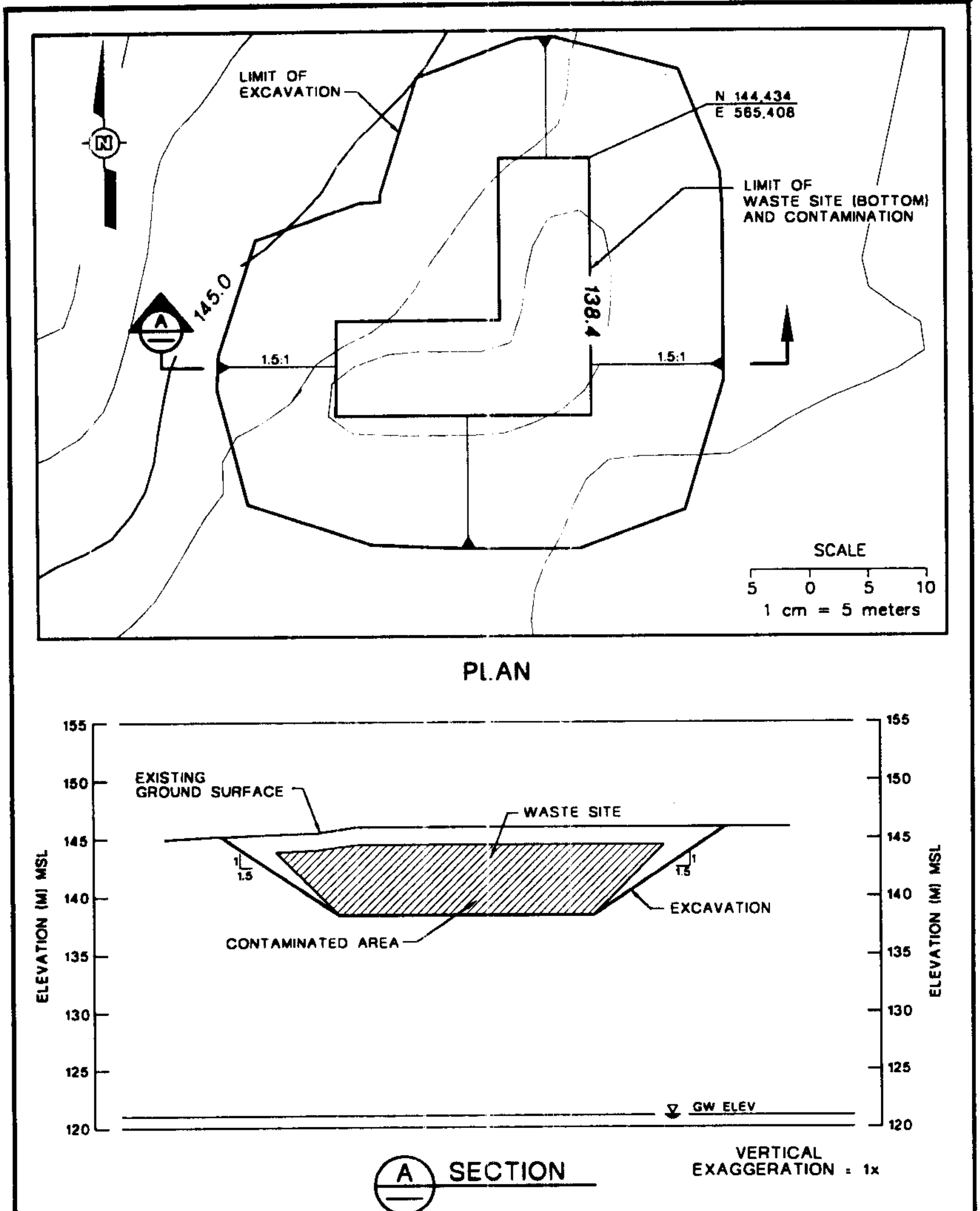
Reference Point: NW corner at surface

ELEVATIONS:

Surface: 145.1 m (476 ft) [3]
Groundwater: 121.0 m (397 ft) [7]

DRAFT

Figure FA1-9. IRM Site: 118-B-5.



EXTENT OF CONTAMINATION

SURFACE AREA = 907 sq. meters
VOLUME = 3,297 cu. meters

EXTENT OF EXCAVATION

SURFACE AREA = 1,505 sq. meters
VOLUME = 5,973 cu. meters

118B5

Volume Estimate
100-BC-1 Operable Unit

SITE NUMBER: 118-B-7
SITE NAME: 111-B Solid Waste Burial Ground

WASTE SITE DIMENSIONS:

Length - 2.4 m (8 ft) along bottom [1]; 7.3 m (24 ft) along top [10]
Width - 2.4 m (8 ft) along bottom [1]; 7.3 m (24 ft) along top [10]
Depth - 2.4 m (8 ft) [1]
Slopes - 1.0 H : 1.0 V [9]
Orientation - Oriented N-S [2]

Waste site has been covered with 1.5 m (5 ft) (mounded) of backfill [1]. Backfill is considered uncontaminated.

CONTAMINATED VOLUME DIMENSIONS:

No contamination extends beyond the limits of the site [9]

Length - 2.4 m (8 ft) along bottom; 7.3 m (24 ft) along top
Width - 2.4 m (8 ft) along bottom; 7.3 m (24 ft) along top
Depth - 2.4 m (8 ft) below grade

EXCAVATED VOLUME DIMENSIONS:

Bottom of excavation is 2.4 m (8 ft) x 2.4 m (8 ft) at a depth of 2.4 m (8 ft) below grade (excluding overburden).
Excavation Slopes - 1.5 H : 1.0 V
See attached figure for excavation top dimensions.

WASTE SITE LOCATION:

Northing: 145,359
Easting: 565,379

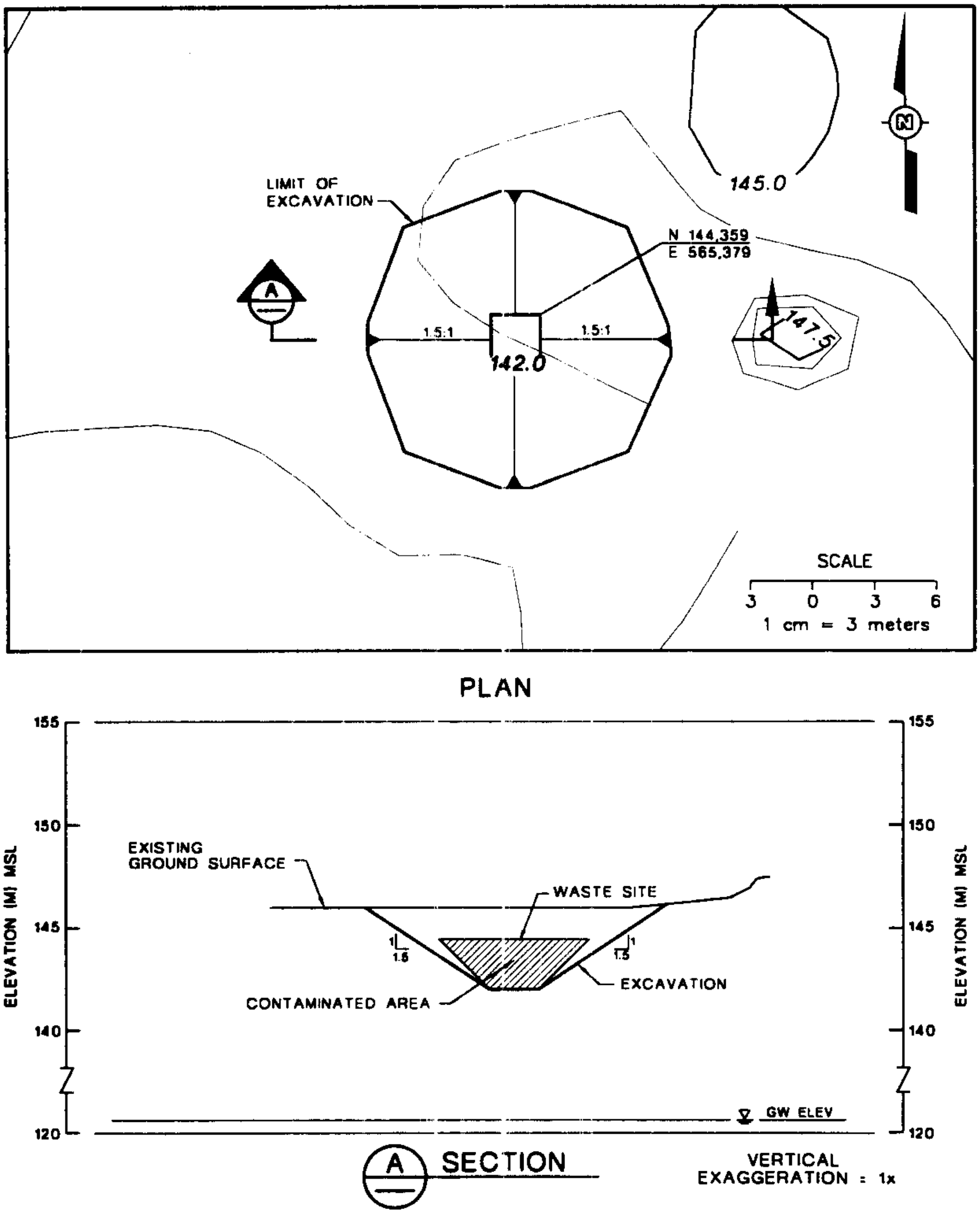
Reference Point: Northeast corner at surface

ELEVATIONS:

Surface: 145.1 m (476 ft) [3]
Groundwater: 121.0 m (397 ft) [7]

DRAFT

Figure FA1-10. IRM Site: 118-B-7.



EXTENT OF CONTAMINATION

SURFACE AREA = 46 sq. meters
VOLUME = 61 cu. meters

EXTENT OF EXCAVATION

SURFACE AREA = 164 sq. meters
VOLUME = 268 cu. meters

118B7

Volume Estimate
100-BC-1 Operable Unit

SITE NUMBER: 118-B-10
SITE NAME: Pit/Burial Ground

WASTE SITE DIMENSIONS:

Length - 14.6 m (48 ft) along bottom [1]; 26.8 m (88 ft) along top [10]
Width - 5.6 m (18 ft) along bottom [1]; 17.7 m (58 ft) along top [10]
Depth - 6.1 m (20 ft)
Slopes - 1.0 H : 1.0 V [9]
Orientation - Oriented E-W [2]

Waste site has been covered with 2.4 m (8 ft) (0.9 m [3 ft] mounded) of backfill [1]. Backfill is considered uncontaminated.

CONTAMINATED VOLUME DIMENSIONS:

No contamination extends beyond the limits of the site [9].

Length - 14.6 m (48 ft) along bottom; 26.8 m (88 ft) along top
Width - 5.5 m (18 ft) along bottom; 17.7 m (58 ft) along top
Depth - From 2.4 m (8 ft) to 8.5 m (28 ft) below grade

EXCAVATED VOLUME DIMENSIONS:

Bottom of excavation is 14.6 m (48 ft) x 5.6 m (18 ft) at a depth of 8.5 m (28 ft)
Excavation Slopes - 1.5 H : 1.0 V
See attached figure for excavation top dimensions.

WASTE SITE LOCATION:

Northing: 145,477
Easting: 565,320

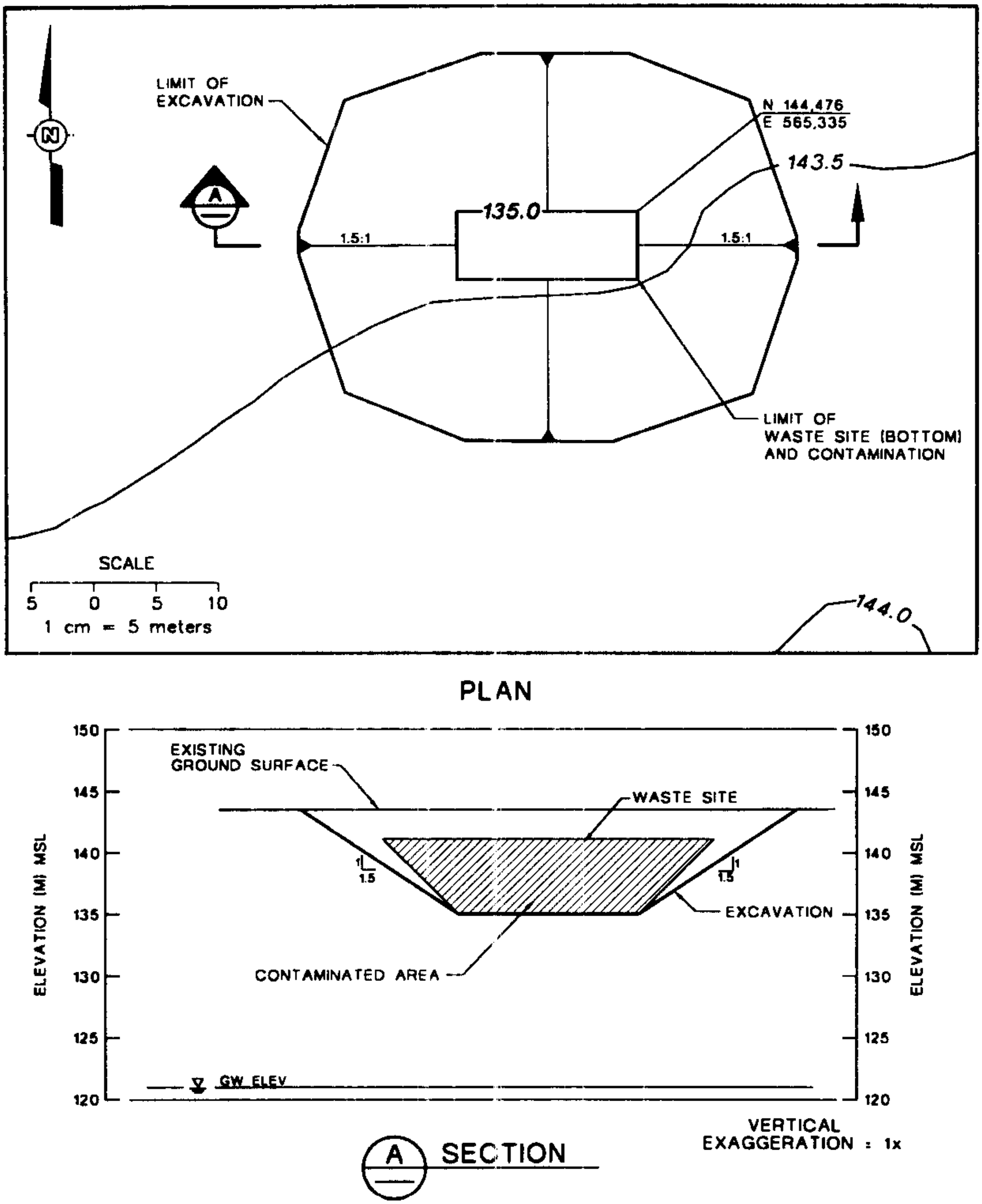
Reference Point: Northeast corner at bottom

ELEVATIONS:

Surface: 143.9 m (472 ft) [3]
Groundwater: 121.0 m (397 ft) [7]

DRAFT

Figure FA1-11. IRM Site: 118-B-10.



EXTENT OF CONTAMINATION

SURFACE AREA : 402 sq. meters
VOLUME : 1,346 cu. meters

EXTENT OF EXCAVATION

SURFACE AREA : 1,045 sq. meters
VOLUME : 4,054 cu. meters

118B10

Volume Estimate
100-BC-1 Operable Unit

SITE NUMBER:
SITE NAME: Effluent Pipelines (soil and sludge)

WASTE SITE DIMENSIONS:

Length - 3,246 m (10,650 ft) [2]
Width - 1.7 m (66 in.) [2]
Length - 1,494 m (4,900 ft) [2]
Width - 1.5 m (60 in.) [2]
Length - 134 m (440 ft) [2]
Width - 1.4 m (54 in.) [2]
Length - 716 m (2,350 ft) [2]
Width - 1.2 m (48 in.) [2]

Length - 320 m (1,050 ft) [2]
Width - 1.1 m (42 in) [2]
Length - 463 m (1,520 ft) [2]
Width - .6 m (24 in) [2]
Length - 160 m (524 ft) [2]
Width - .5 m (18 in) [2]

CONTAMINATED VOLUME DIMENSIONS:

Soil around pipe. See Pipeline Leak at B/C Junction Box.

Sludge inside pipe. All pipes have contaminated sludge along bottom. Volume of sludge is insignificant, the volume calculated will be that of pipe void.

EXCAVATED VOLUME DIMENSIONS:

Depends on depth of pipe. Base of excavation is 0.6 m (2 ft) on each side of the pipe and begins 3 in. below invert of pipe.

Excavation Slopes - 1.5 H : 1.0 V

WASTE SITE LOCATION:

See figure.

ELEVATIONS:

See figure.

DRAFT

Volume Estimate
100-BC-1 Operable Unit

SITE NUMBER: N/A
SITE NAME: Pipeline Leak at B/C Junction Box

WASTE SITE DIMENSIONS:

The contamination is associated with a leak around a 54-in. steel pipeline and the associated junction box leading to the 116-C-5 Retention Basins [5].

Assume pipeline is in a gravel bed 3 in. below, 6 in. above and 0.6 m (2 ft) on either side of the pipe. Assume top of gravel bed is 4.5 m (15 ft) below grade.

Pipeline is in a trench with 1 H : 1 V side slopes.

CONTAMINATED VOLUME DIMENSIONS:

Assume contamination has spread throughout the gravel bed and then downward below the site.

Length - 76.2 m (250 ft)
Width - 5.8 m (19 ft)
Depth - 3 m (10 ft); from 4.6 m (15 ft) to 7.6 m (25 ft) below grade

EXCAVATED VOLUME DIMENSIONS:

Bottom of excavation is 76.2 m (250 ft) x 5.8 m (19 ft) at a depth of 7.6 m (25 ft) below grade.
Excavation Slopes - 1.5 H : 1.0 V
See attached figure for excavation top dimensions.

WASTE SITE LOCATION:

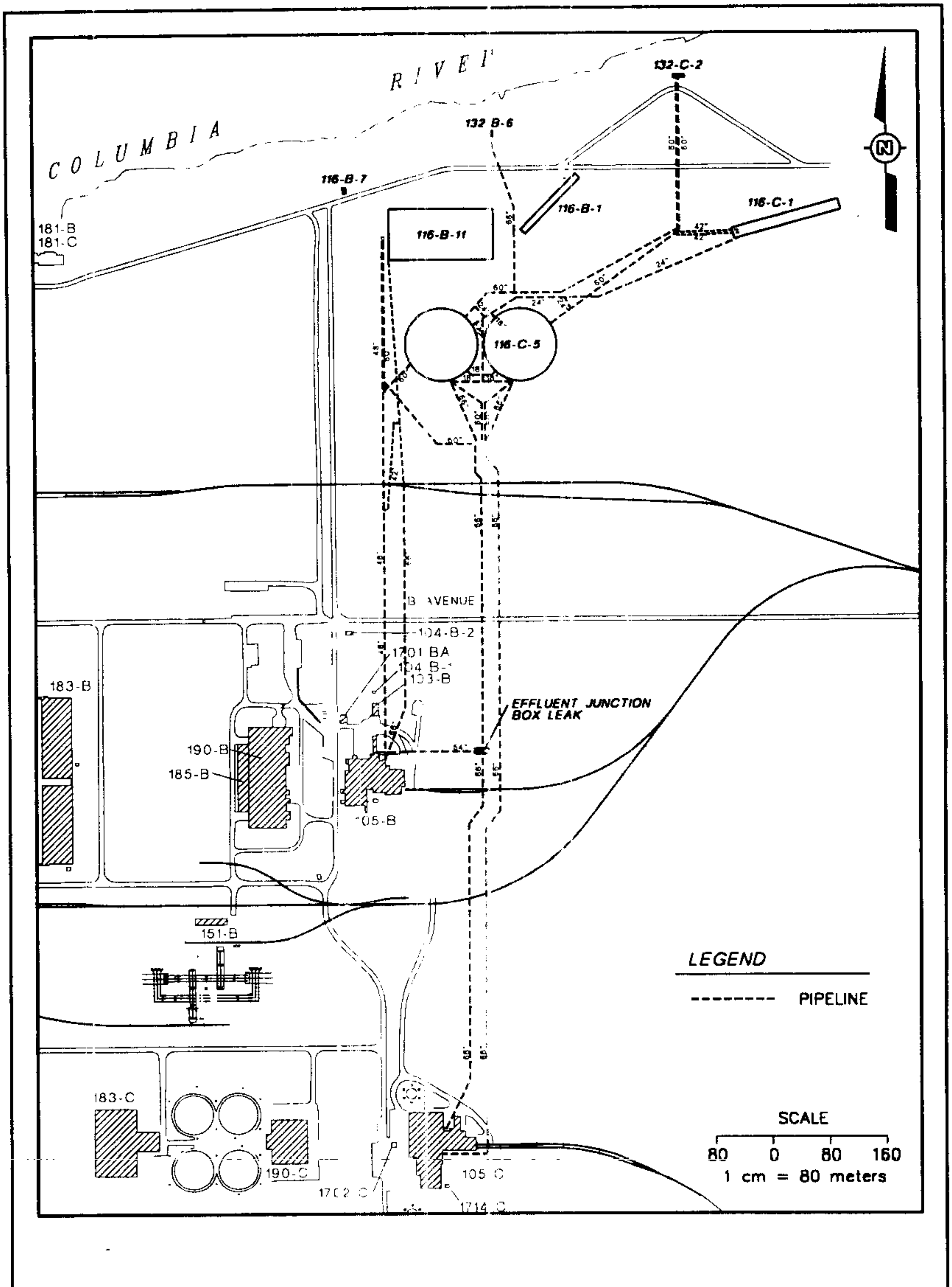
Northing: 144,551
Easting: 565,440

Reference Point: Junction Box

ELEVATIONS:

Surface: 142 m (466 ft) [10]
Groundwater:

Figure FA1-12. IRM Site: 100 B/C Pipelines.



100BCPLN

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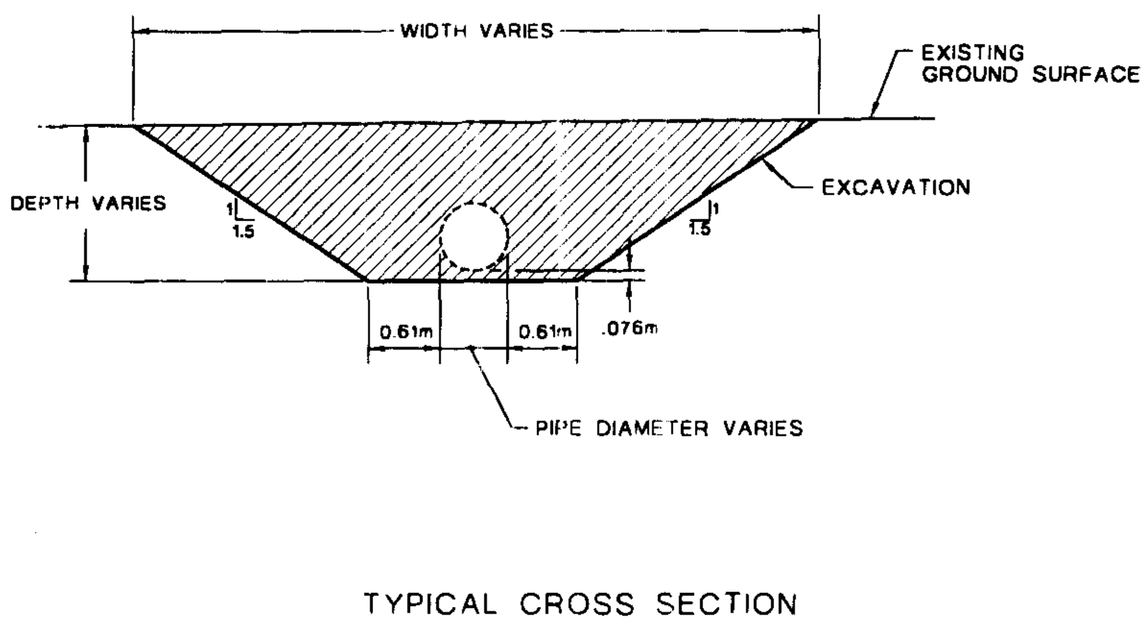
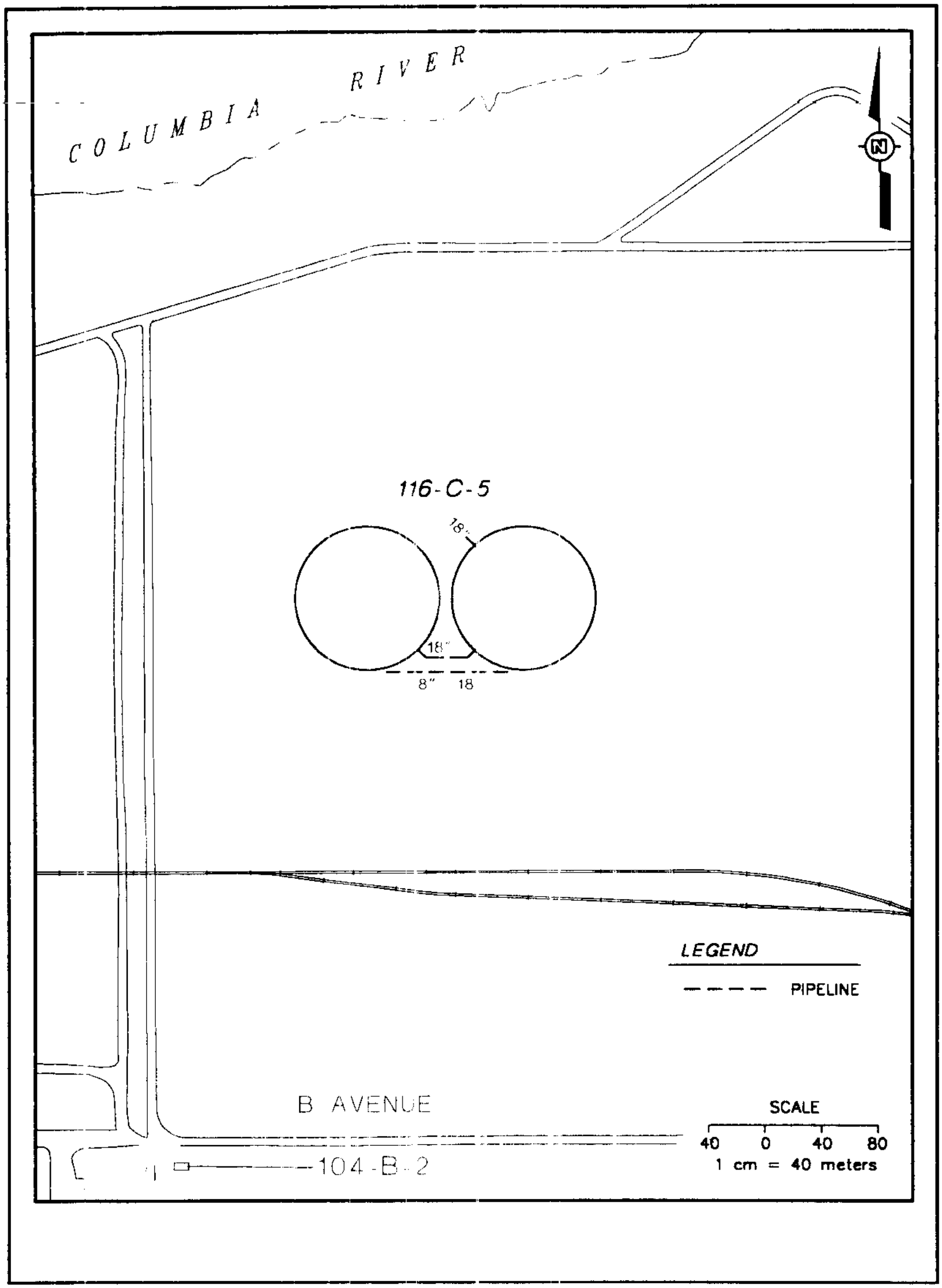
Figure FA1-13. Typical Pipeline Excavation Cross Section.



PEXSEC

Figure FA1-14. 100 B/C 18-in. Pipelines.



PLN18

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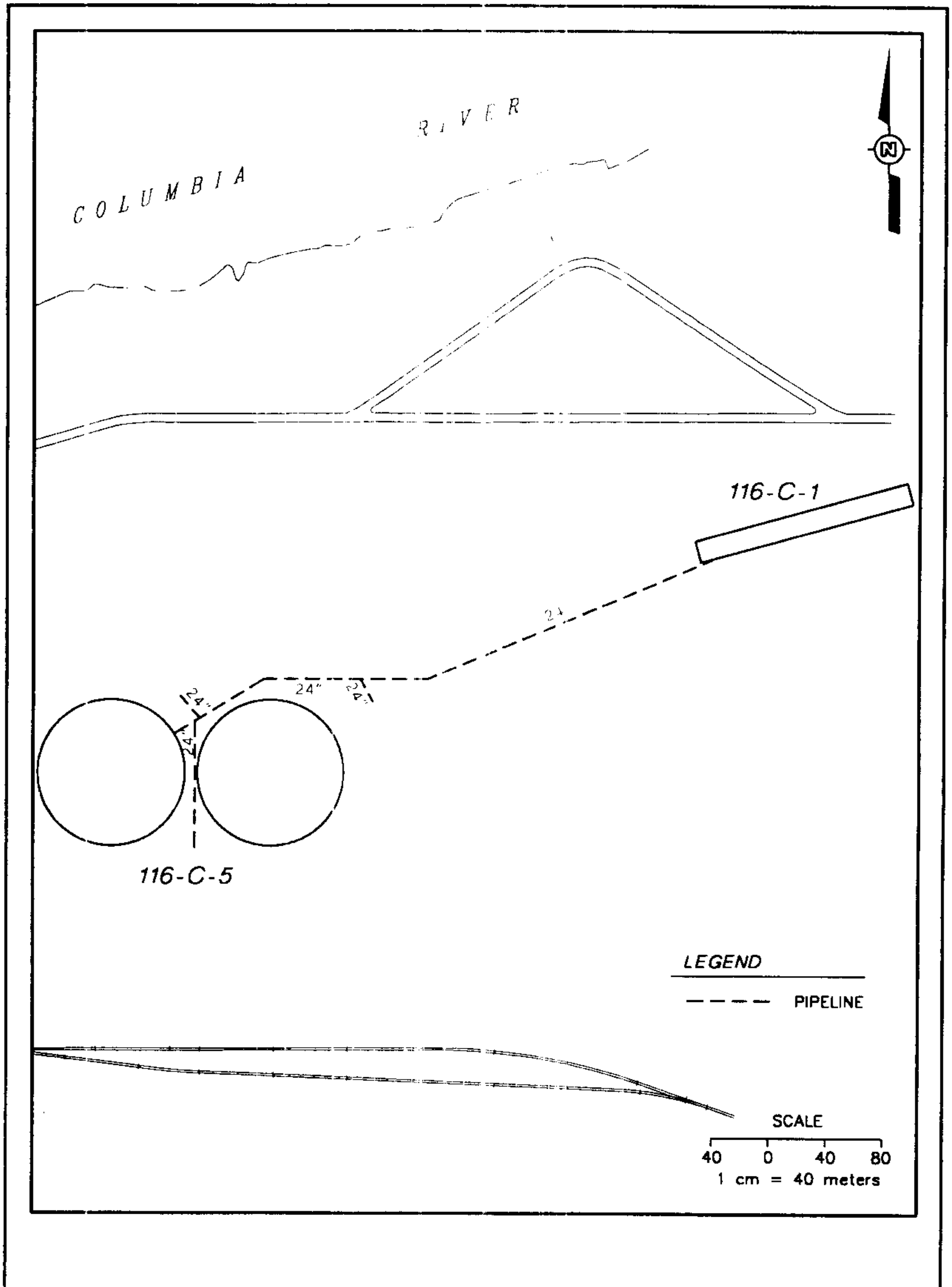
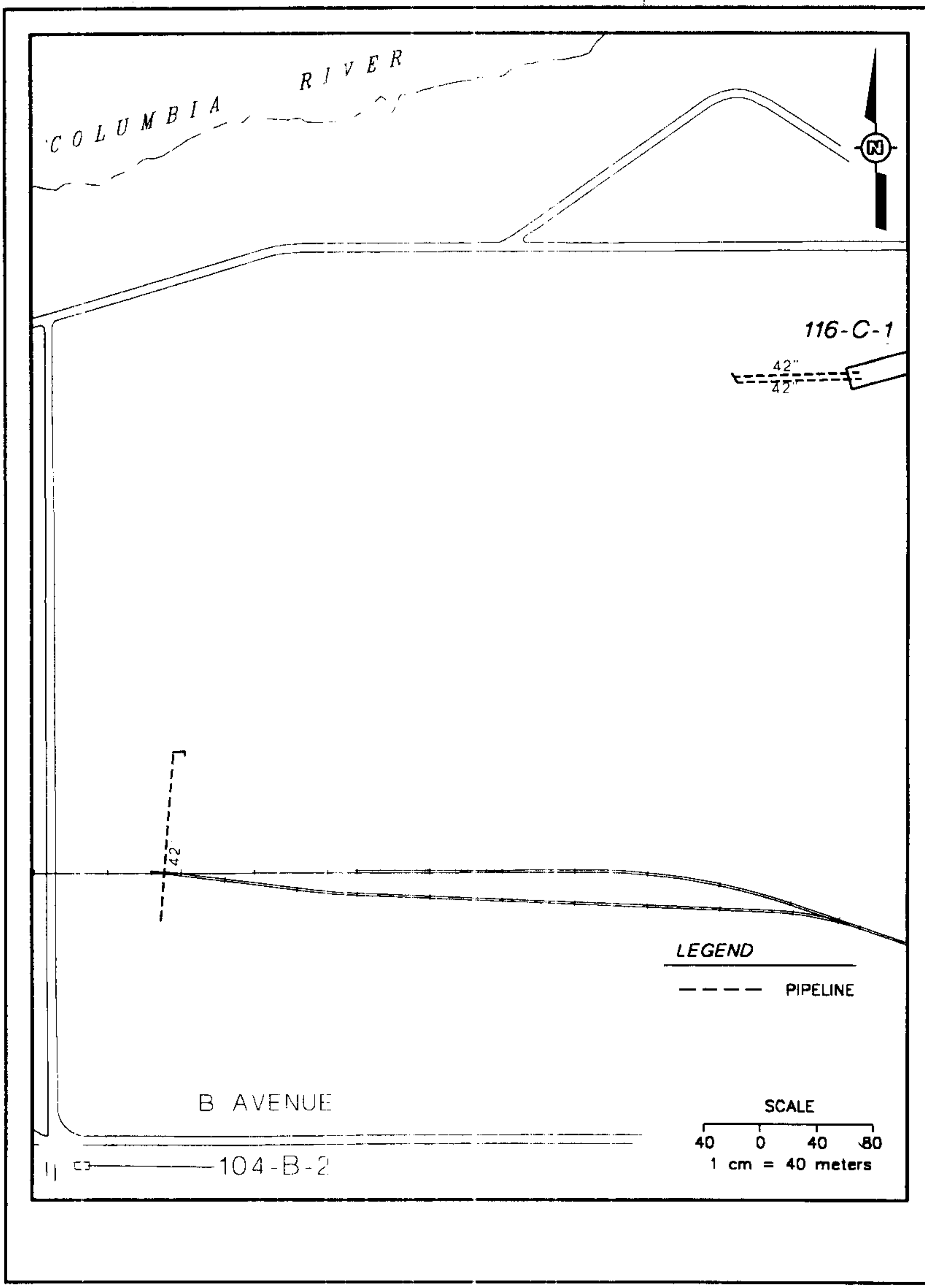
Figure FA1-15. 100 B/C 24-in. Pipelines.



PLN24

Figure FA1-16. 100 B/C 42-in. Pipelines.



PLN42

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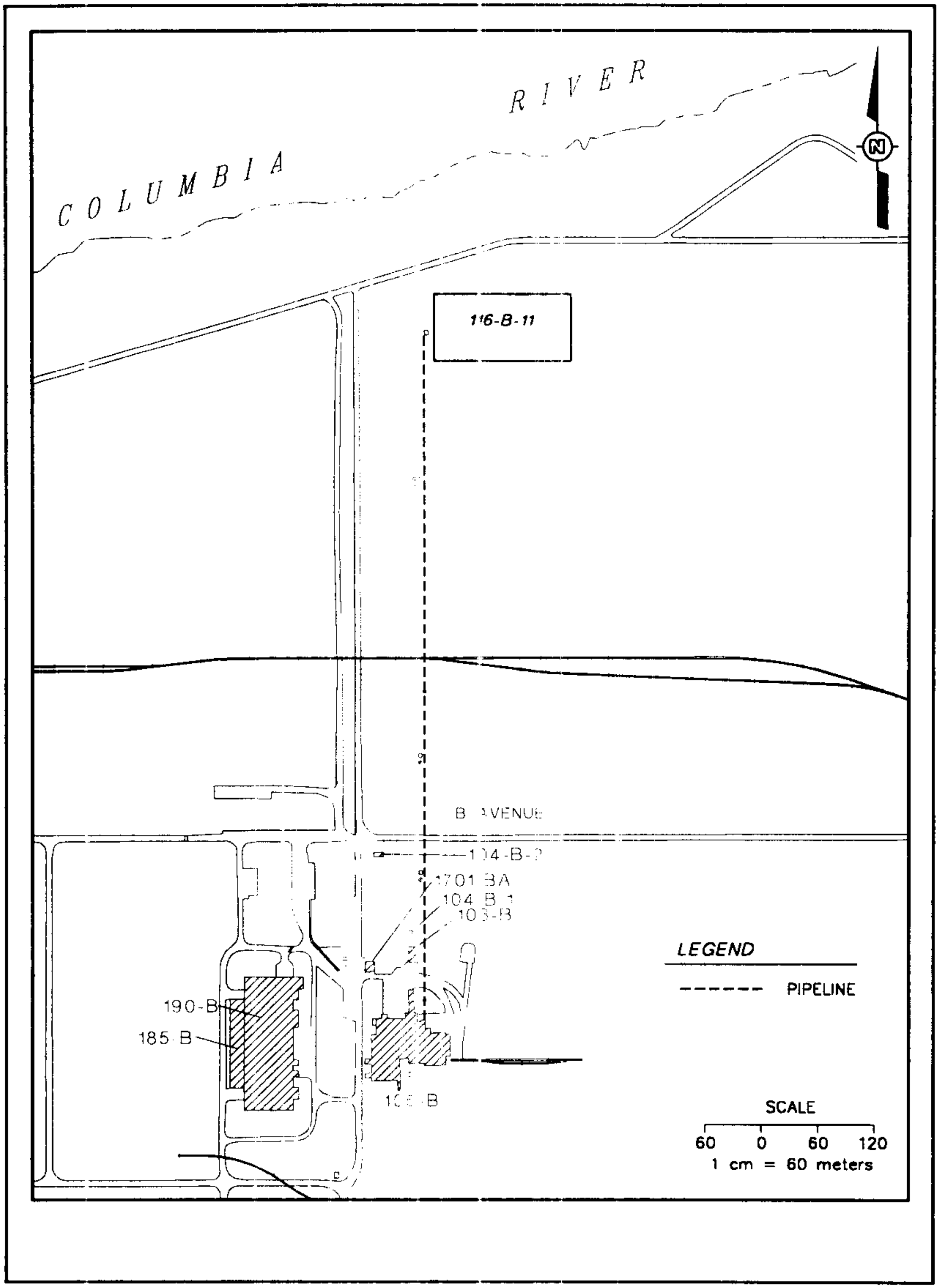
Figure FA1-17. 100 B/C 48-in. Pipelines.



PLN48

Figure FA1-18. 100 B/C 54-in. Pipelines.

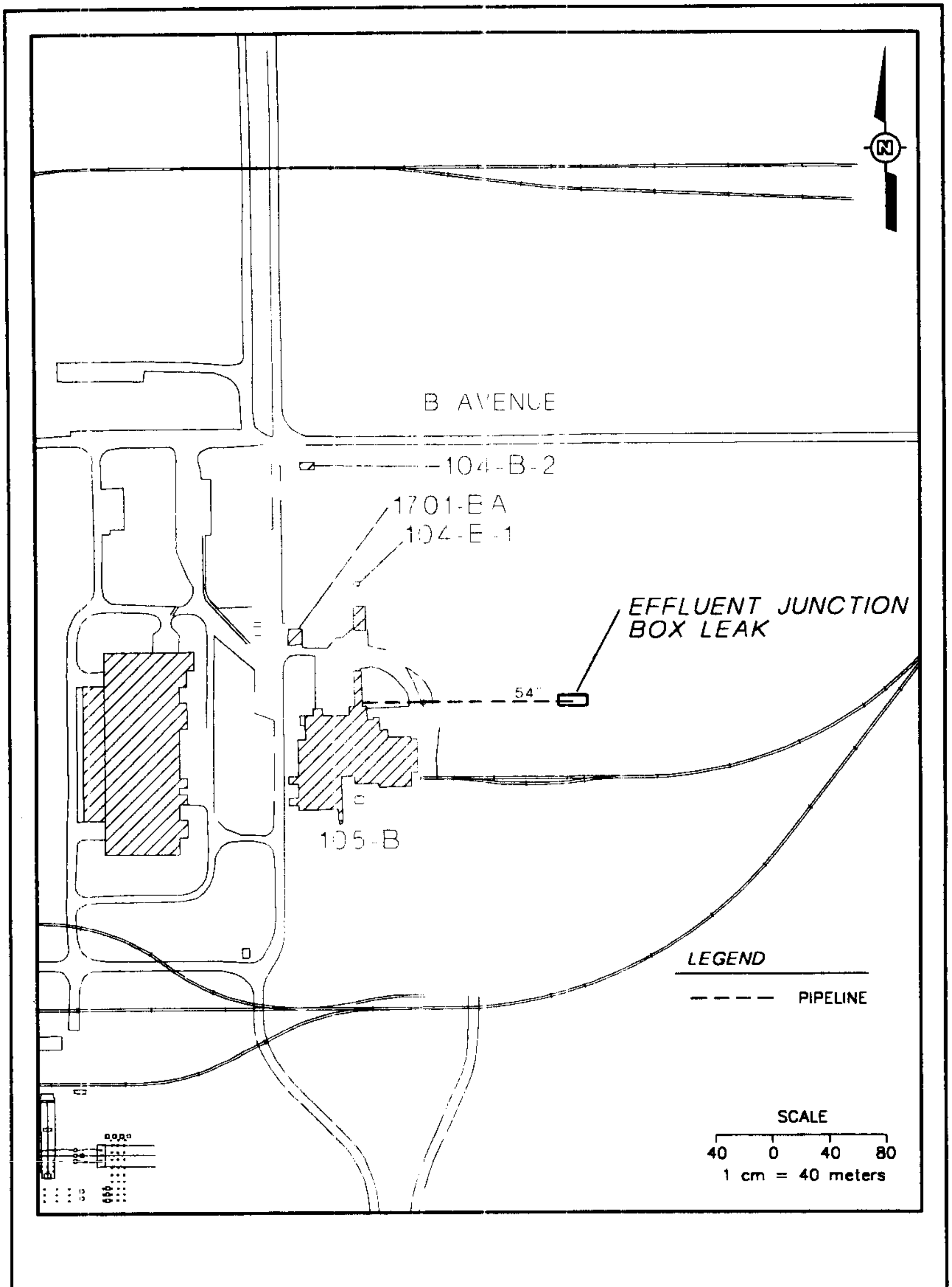


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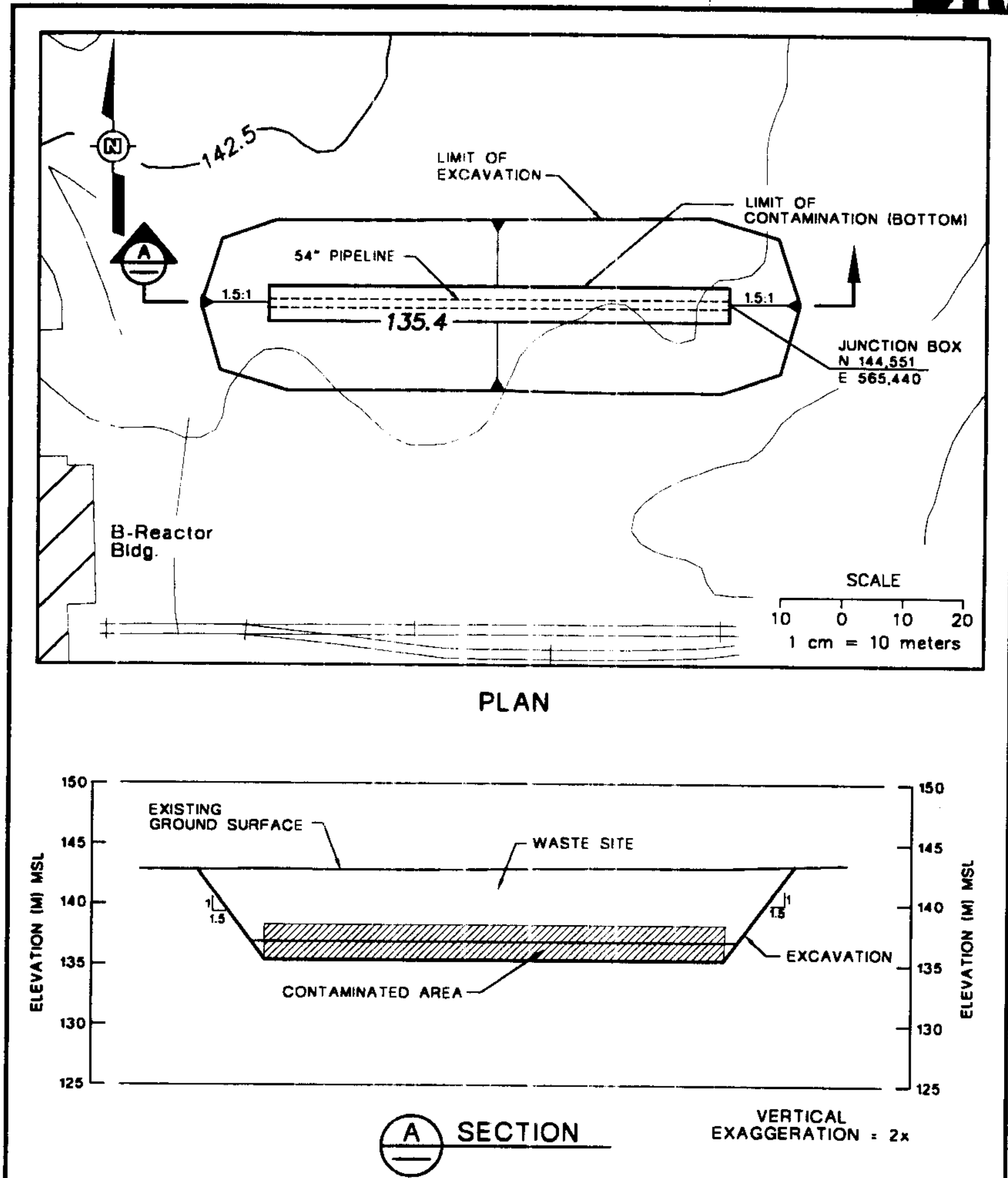
Figure FA1-19. 100 B/C 54-in. Pipeline at Junction Box Leak.



EXTENT OF CONTAMINATION

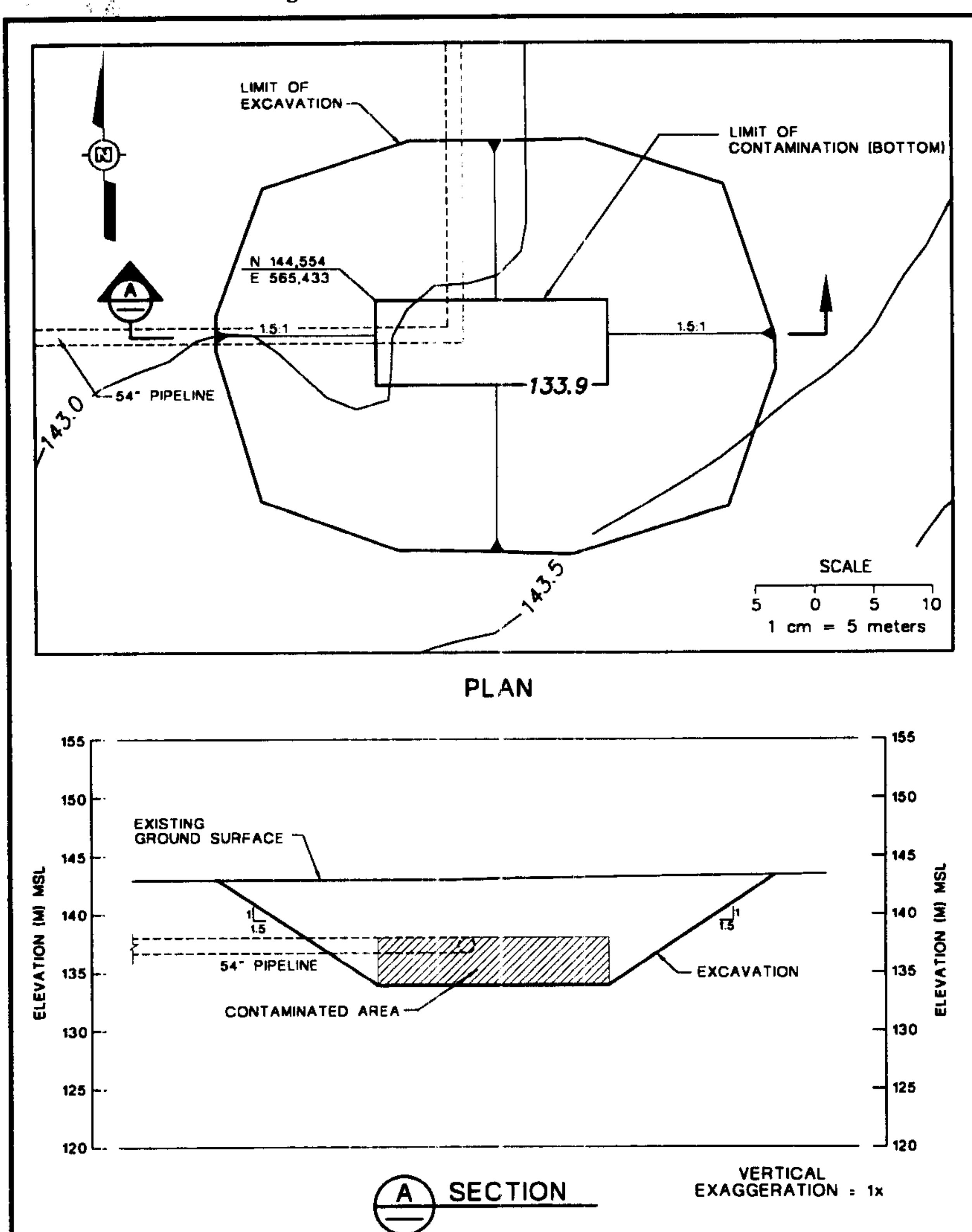
SURFACE AREA = 441 sq. meters
VOLUME = 1,325 cu. meters

EXTENT OF EXCAVATION

SURFACE AREA = 2,637 sq. meters
VOLUME = 11,117 cu. meters

54LEAK

Figure FA1-20. 100 B/C Junction Box Leak.



EXTENT OF CONTAMINATION

SURFACE AREA = 144 sq. meters
VOLUME = 665 cu. meters

EXTENT OF EXCAVATION

SURFACE AREA = 1,413 sq. meters
VOLUME = 6,358 cu. meters

54JUNC

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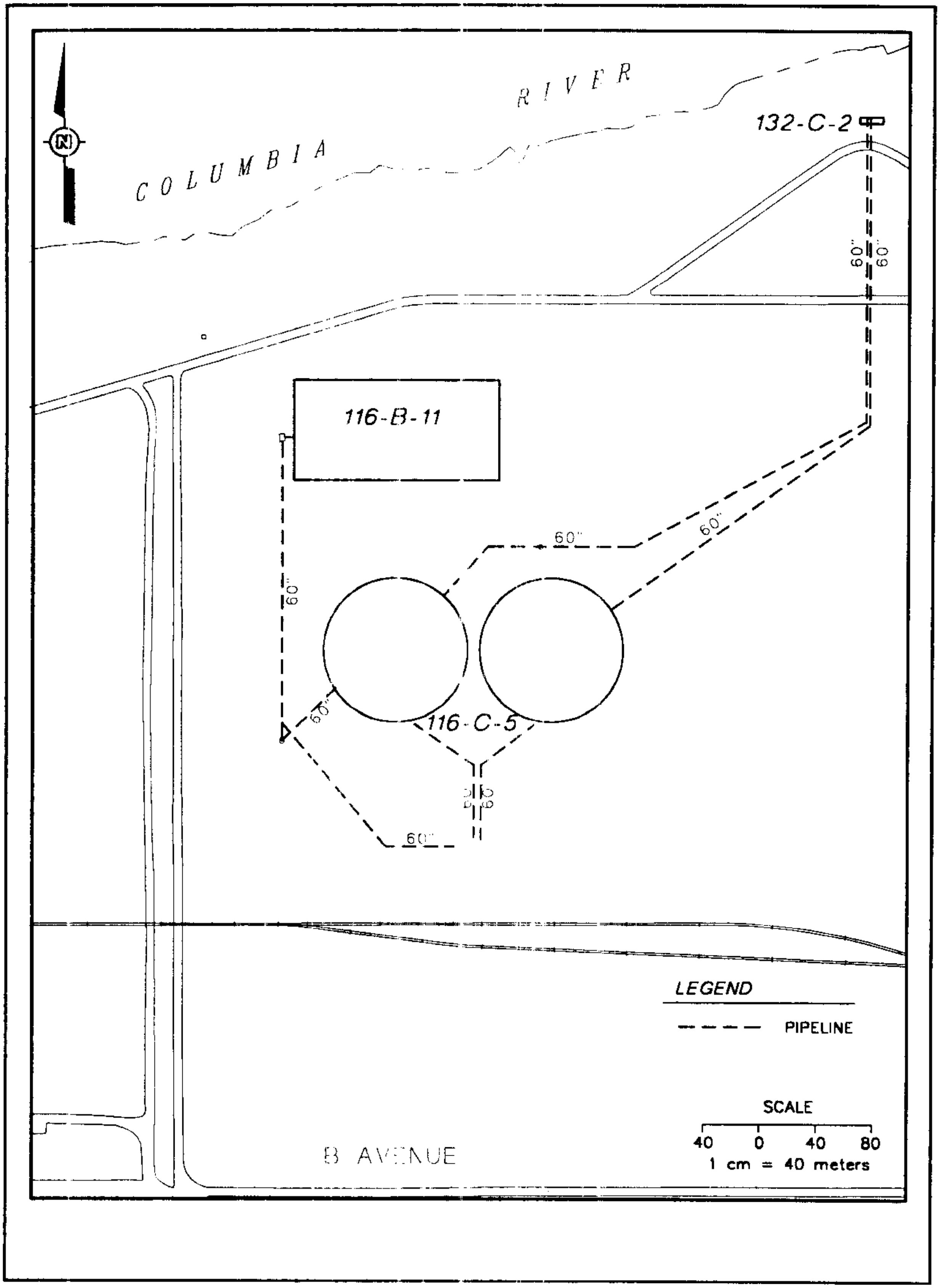
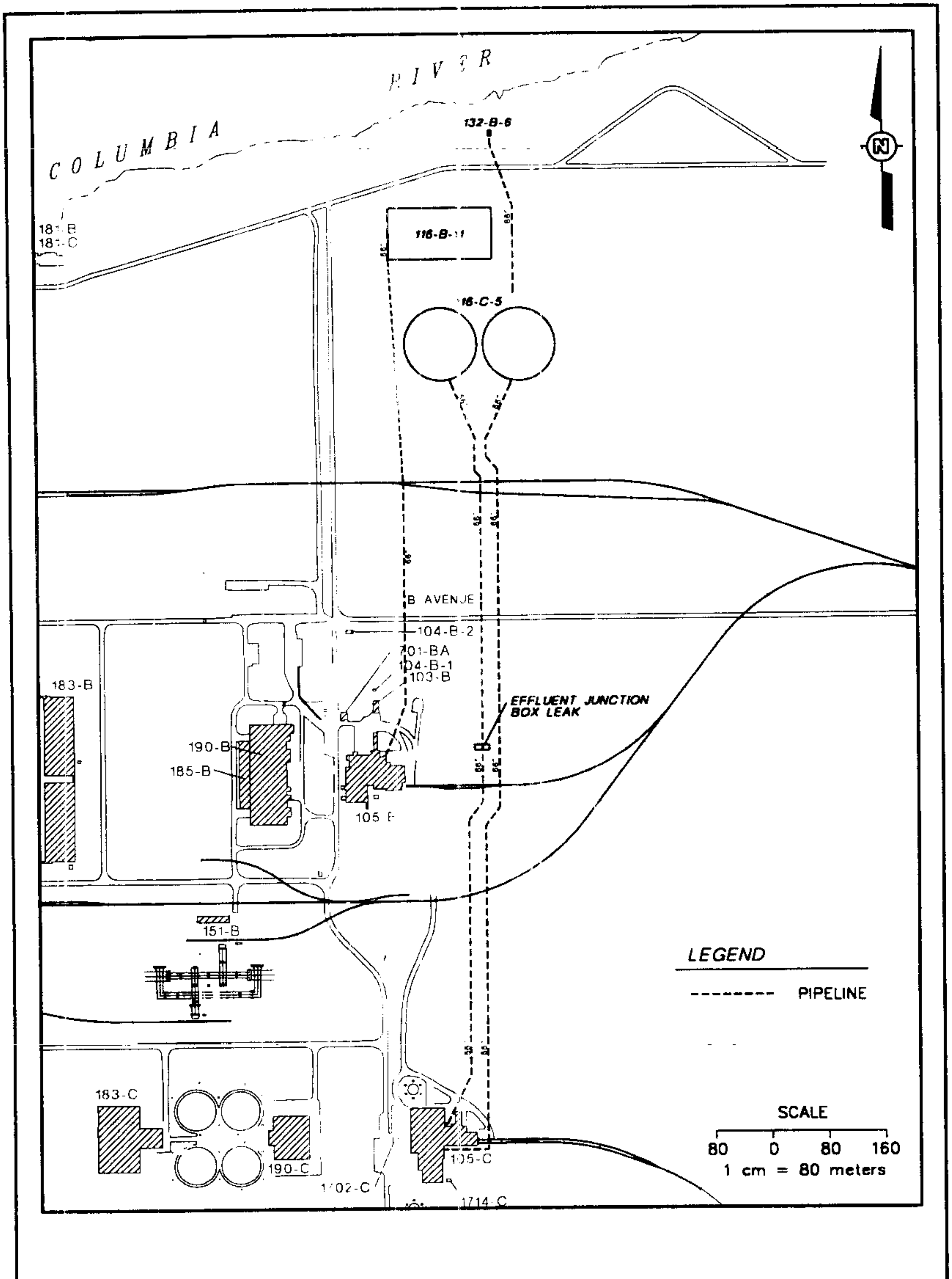
Figure FA1-21. 100 B/C 60-in. Pipelines.



PLN60

Figure FA1-22. 100 B/C 66-in. Pipelines.



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ATTACHMENT 2

100-BC-1 OPERABLE UNIT WASTE SITE COST ESTIMATES

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APPENDIX G

100-DR-1 OPERABLE UNIT FOCUSED FEASIBILITY STUDY REPORT

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ACRONYMS

ARAR	applicable or relevant and appropriate requirements
ARCL	allowable residual contamination level
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
COPC	contaminants of potential concern
D&D	decontamination and decommissioning
EPA	U.S. Environmental Protection Agency
FFS	focused feasibility study
FS	feasibility study
HPPS	Hanford Past-Practice Strategy
ICR	incremental cancer risk
IRM	interim remedial measure
LFI	limited field investigation
O&M	operation and maintenance
PRG	preliminary remediation goals
QRA	qualitative risk assessment
RAO	remedial action objective
RCRA	*Resource Conservation and Recovery Act*
RI	Remedial Investigation

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CONTENTS

CONTENTS (continued)

FIGURES

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CONTENTS (continued)

TABLES

CONTENTS (continued)

TABLES (continued)

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1.0 INTRODUCTION

This 100-DR-1 Operable Unit FFS is prepared in support of the CERCLA RI/FS process for the 100 Areas. As discussed in Section 1.0 of the Process Document (Sections 1.0 through 6.0 of the main report plus Appendices A, B, and C), the approach for the RI/FS activities for the 100 Areas has been defined in the Hanford Past Practice Strategy (DOE-RL 1991). The HPPS emphasizes timely integration of ongoing site characterization activities into the decision making process (the observational approach) and expedites the remedial action process by emphasizing the use of interim actions. This 100-DR-1 FFS, therefore, evaluates the Remedial Alternatives for interim action at twenty high-priority (candidates for interim remedial measures) waste sites within the 100-DR-1 Source Operable Unit, and provides the information needed for the timely selection of the most appropriate interim action at each waste site. The high-priority waste sites were originally defined in the 100-DR-1 Work Plan and further described in the Limited Field Investigation and Qualitative Risk Assessment (DOE-RL 1994 and WHC 1993).

As shown in Figure 1-2 of the Process Document, the FFS process for the 100 Areas is conducted in two stages: an evaluation of Remedial Alternatives for waste site groups (the Process Document) and an evaluation of the Remedial Alternatives for individual waste sites (the Operable Unit FFS). In this FFS, the evaluation of alternatives for cleaning up individual waste sites uses the previously developed evaluation of alternatives for waste site groups whenever possible. That is, whenever the characteristics of the individual waste sites are sufficiently similar to the characteristics of the waste site groups. This approach, referred to as the "plug-in" approach, is used because there are many waste sites within the 100 Areas that are very similar to each other. This "plug-in" approach is further described in Sections 1.1 and 1.4 of the Process Document. The remedial action objectives and preliminary remediation goals that direct the analysis of alternatives in both the Process Document and the FFS are defined in Section 2.0 of the Process Document.

The evaluation of alternatives in the Process Document was conducted by establishing remedial goals based primarily on human health risk goals assuming an occasional use of land surface and soil remediation to support frequent use of groundwater. This 100-DR-1 FFS Appendix also includes an evaluation of alternatives using these health-risk based goals via the "plug-in" approach. However, Ecology, EPA, and DOE recently decided to establish interim soil remedial goals based on the State of Washington's MTCA B regulations for organic and inorganic chemicals, and EPA's proposed standard of 15 mrem/yr (above background) for radionuclides. Therefore, this 100-DR-1 FFS Appendix contains an additional comparative analysis section (Section 7.0) that describes how the results of the original alternative analyses in the Process Document and Sections 1.0 through 6.0 of this appendix may change as a result of using the new (MTCA B, 15 mrem) cleanup goals. The results of the Sensitivity Analysis (Appendix D) was also used to evaluate the influence of revising cleanup goals because it evaluated the Remedial Alternatives using several different combinations of land and groundwater uses, including the baseline exposure scenario in the Process Document and the latest MTCA B and 15 mrem approach (the revised frequent use scenario). The conclusions reached in this 100-DR-1 FFS regarding interim Remedial Alternatives are presented in Section 7.0.

1.1 PURPOSE AND SCOPE

The scope of this document is limited to 100-DR-1 Operable Unit interim remedial measure candidate sites, as determined in the Limited Field Investigation (DOE-RL 1994). Impacted groundwater beneath the 100-D Area will be addressed in a separate 100-HR-3 FFS. In addition, low-priority waste sites and potentially impacted river sediments near the 100 Area are not considered candidates for interim remedial measures; they are being addressed under the remedial investigation/corrective measures study pathway of the Hanford Past Practice Strategy (DOE-RL 1991). The decision to limit the scope of the FFS is documented and justified in the work plan, the 100 Area Feasibility Study Phase I and II (DOE-RL 1993), and the Limited Field Investigation (DOE-RL 1994).

This report presents the following:

- 100-DR-1 Operable Unit individual waste site information (Section 2.0)
- Development of individual waste site profiles (Section 2.0)
- Identification of representative groups for individual waste sites and a comparison against the applicability criteria and identification of appropriate enhancements for the alternatives (Section 3.0)
- Discussion of the deviations and/or enhancements of an alternative and additional alternative development, as needed (Section 4.0)
- Detailed analyses for sites that deviate from the representative group alternatives (Section 5.0)
- A comparative analysis for all individual waste sites using the Process Document baseline scenario (Section 6.0)
- A discussion of the modifications and associated comparative analysis to the baseline scenario from the results of the Sensitivity Analysis (Section 7.0)
- None of the waste sites require additional alternative development
- All of the waste sites directly plug into the waste site group alternatives, except for the effluent pipelines. The site-specific detailed analysis is conducted, referencing the waste site group analysis, as appropriate.
- A comparative analysis of Remedial Alternatives is presented for each waste site.

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1.2 INCORPORATION OF NATIONAL ENVIRONMENTAL POLICY ACT VALUES

In accordance with DOE Order 5400.4 and Chapter 10 of the *Code of Federal Regulations* (CFR) Part 1021, the considerations (values) of the *National Environmental Policy Act of 1969* (NEPA) are to be incorporated in the CERCLA process. The NEPA values are, therefore, incorporated into the Process Document (e.g., Sections 3.3 and 5.2).

Several NEPA values, such as a description of the affected environment (including meteorology, hydrology, geology, ecological resources, and land use), applicable laws and guidelines, short-term and long-term impacts on human health and the environment, and cost are included within a typical CERCLA feasibility study. Other NEPA values not normally addressed in a CERCLA feasibility study, such as socio-economic impacts, cultural resources, and transportation impacts, have been evaluated in the Process Document.

The NEPA impacts that are specific to the 100-DR-1 Operable Unit and a detailed analysis of alternatives, as applicable, are addressed in Section 5.0 of this document.

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2.0 WASTE SITE INFORMATION

2.1 OPERABLE UNIT BACKGROUND

The 100 Area at the Hanford Site is located in Benton County along the southern banks of the Columbia River, in the north central part of the site (Figure 2-1). The 100-DR-1 Operable Unit comprises the northern half of the 100-D/DR Area and is located immediately adjacent to the Columbia River shoreline. The 100-DR-1 Operable Unit encompasses approximately 1.5 km^2 (0.59 mi^2) of the 100-D/DR Area. It lies predominately in the southeast quadrant of Section 15 and the southwest quadrant of Section 14 of Township 14N, Range 26E.

The 100-D/DR Area contains two separate reactors, the D and DR Reactors. The D Reactor is closer to the Columbia River and about 228.6 m (750 ft) north of the DR Reactor. Many of the support facilities for both reactors, such as the cooling water retention basins and sludge trenches are located closer to the river than either reactor (Figure G2-1). The 100-DR-1 Operable Unit is one of three operable units associated with the 100-D/DR Area. The 100-DR-1 and 100-DR-2 Operable Units are source operable units, while the third operable unit addresses groundwater. The 100-DR-1 Operable Unit includes the D Reactor (105-D); the retention basins, sludge trenches, and fuel storage basin trenches; and burial grounds and liquid disposal facilities associated with the D Reactor. The 100-DR-2 Operable Unit includes the DR Reactor (105-DR), cask storage pad, sodium dichromate tanker car off-loading facility, several solid waste burial grounds, burn pits, and liquid disposal facilities associated with the DR Reactor. The groundwater below the source operable units in the 100-D/DR Area is being addressed in the 100-HR-3 Operable Unit because the groundwater flows predominantly towards the east-northeast under the 100-H Area and then into the Columbia River. The 100-HR-3 Operable Unit FFS is addressing contamination that has migrated to the groundwater from both of the 100-D/DR Area source operable units, and from the source operable units in the 100-H Area approximately 3.5 km (2 mi) northeast of the 100-D/DR Area. The 100-HR-3 Operable Unit also addresses potential contaminant migration to sediments, surface water, and biota in and adjacent to the Columbia River.

The 100-D and 100-DR Reactors were the second and fourth Hanford Site reactors built to manufacture plutonium during World War II. Fuel elements for the reactor were assembled in the 300 Area, and the plutonium-enriched fuel produced by the reactor was processed in the 200 Area. The 100-D Reactor operated from 1945 to 1967, when it was retired. The 100-DR Reactor began operation in 1950 and was retired in 1964. After the reactors were retired, decontamination and decommissioning activities were initiated to minimize the potential spread of radioactive and other potential contaminants. This process is ongoing, although most of the structures in the 100-D/DR Area have been demolished.

Since the preparation of the *100 Area Feasibility Study Phases 1 and 2* (DOE-RL 1993a), additional data relevant to this FFS have been collected in both the 100 Area in general, and in the 100-DR-1 Operable Unit specifically. An LFI and QRA were performed for the 100-DR-1 Operable Unit (DOE-RL 1993b, WHC 1993). A work plan was prepared for 100-DR-2 Operable Unit (DOE-RL 1994b). In addition, aggregate area studies were conducted to evaluate cultural and ecological resources within the 100 Area.

2.2 100 AREA AGGREGATE STUDIES

Hanford Site studies and studies within the 100 Area, such as the Hanford Site Background studies, provide integrated analyses of selected issues on a scale larger than the operable unit. The 100 Area groundwater operable unit work plans (e.g., DOE-RL 1992b, 1992c, and 1992d [the work plans for HR-3, FR-3, and KR-4]) provide information common to the 100 Area, covering topics such as river impacts, shoreline ecology, and cultural resources. The 100-D/DR Area source operable unit work plans provide detail on the physical setting within the 100-D/DR Area, such as land form, geology, groundwater, surface water, meteorology, natural resources, and human resources (e.g., DOE-RL 1992a and 1994b). Studies that are applicable to the 100 Area source operable unit FFS are summarized in the following subsections.

2.2.1 Hanford Site Background Study

The characterization of the natural chemical composition of Hanford Site soils is presented in *Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes* (DOE-RL 1993c). The background values for inorganic constituents in soils, based on the above report, are discussed in Section 2.0 and Appendix A of the Process Document. Background values for radionuclides are currently under evaluation, but only a few are available at this time (see Appendix A of the Process Document).

2.2.2 Ecological Studies

Bird, mammal, and plant surveys in the 100 Area were conducted and reported by Sackschewsky and Landeen (1992). Conceptual food pathways and inventories of wildlife and plants at the Hanford Site, including threatened and endangered species, were presented by Weiss and Mitchell (1992). Cadwell (1994) described the aquatic species in the Hanford Reach of the Columbia River, the spatial distribution of vegetation types at the Hanford Site, and surveys of species of concern, such as the shrub-steppe vegetation, threatened and endangered birds, and mule deer and elk populations. Cadwell (1994) concluded that intrusive-type remedial activities conducted inside the controlled-area fences should not have a significant impact on the wildlife. Landeen et al. (1993) stated that intrusive activities outside the controlled-area fences should have minimal impact on protected wildlife species if the recommendations contained in the three documents listed below are followed.

- *Bald Eagle Site Management Plan for the Hanford Site, South Central Washington* (Fitzner and Weiss 1994)

- *Biological Assessment for Threatened and Endangered Wildlife Species* (Fitzner, Weiss, and Stegan 1994)

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- *Biological Assessment for State Candidate and Monitor Species* (Stegen 1992).

The plant communities near the 100-D/DR Area have been broadly described as a riparian community immediately adjacent to the Columbia River and a cheatgrass or rabbit brush/cheatgrass community away from the river. The shoreline immediately adjacent to the 100-D/DR Area is steep with a very narrow riparian zone. A few trees have become established in this narrow riparian zone. This riparian zone supports a wide variety of animals and birds in contrast to the rest of the operable unit.

Many areas within the 100-D/DR Area have been physically disturbed by the original construction and operation of the reactor, and more recently by remedial work on the buildings and waste sites. The central area of the operable unit is essentially devoid of vegetation, with less than 10% cover (Stegen 1994). A cheatgrass/Russian thistle community occurs along the eastern and northern perimeter of the operable unit, and a rabbit brush/cheatgrass community occurs along the river upland of the riparian zone and along the southern boundary. Habitats or vegetation that should be protected from damage during remedial work at the 100-D/DR Area include the few trees in the area and the riparian community along the river.

Bald eagles, a federal and state listed threatened species, are seasonal residents at the Hanford Site, primarily along the river during November through March. There are frequently used roost trees along the river, the northwest boundary of the operable unit, and several frequently used ground perches along the river at the northern end of the 100-D/DR Area. Remedial activities at the 100-D/DR Area will have to be scheduled and conducted to avoid disturbing the eagles feeding and roosting activities. Guidance on issues dealing with bald eagles can be found in the Bald Eagle Site Management Plan (Fitzner and Weiss 1994). Peregrine falcons, a federally listed endangered species, have been observed only infrequently at the Hanford Site. They may use the area as a resting or feeding area during spring and fall migrations, but they do not nest at the Hanford Site.

Other species of concern that could potentially be influenced by remedial work in the 100-D/DR Area include the Swainson's hawk, the ferruginous hawk, sepal yellowcress, and two aquatic molluscs (the Columbia pebblesnail and shortfaced lanx). The molluscs could be impacted if erosion causes an increase in sediment loads in the river or degraded water quality. Swainson's hawks, a state and federal candidate species, nest immediately east and southeast, in the trees planted around the White Bluffs Townsite in the 1940s. These hawks will return to the same nesting sites year after year. Nesting ferruginous hawks are becoming more common at the Hanford Site (Fitzner and Newell 1989), but most nest far southwest of the 100-D/DR Area. Common mammals in the area include mule deer, coyote, Great Basin pocket mouse, jackrabbits, cottontail rabbits, and skunks.

2.2.3 Cultural Resources

Various cultural resource-related investigations have been conducted in the 100 Area over the last few decades. The investigations include archaeological reconnaissances, systematic surveys, test excavations, and interviews with Native Americans with historical ties to the area (Chatters, Gard, and Minthorn 1992; Cushing 1992; Relander 1986;

(Rice 1968 and 1980; Wright 1993). These investigations have resulted in the identification of several archaeological and ethnohistoric sites in and around the 100-D/DR-1 Operable Unit.

The 100-DR-1 Operable Unit is located in an area that has documented cultural resources. For example, several prehistoric sites (45BN442, 45BN443, 45BN444, 45BN439, 45BN459, and 45BN482) have been recorded in or adjacent to the 100-D/DR Reactor Area. Evaluations have not been conducted to establish whether any of these sites are eligible for listing on the National Register of Historic Places, but their presence does indicate that the area is sensitive from a cultural resource standpoint. The 100-DR-1 Operable Unit is also associated with numerous historic sites, primarily associated with early 20th century farming that occurred in this area. These sites also have not been evaluated for National Register eligibility.

It is possible that additional subsurface archaeological deposits exist within the 100-DR-1 Operable Unit, because areas located within 400 m (1,312 ft.) of the Columbia River are considered as having high potential for cultural resources (Chatters 1989). In addition, because discussions with Native American peoples with historical ties to the 100-D/DR Area have yet to take place, other areas might be considered sacred or to be traditional cultural properties; such discussions are planned for 1995.

To identify those waste sites that pose potentially significant risk to cultural resources, cultural resource impact assessments are being conducted for each waste site in the 100-D/DR Area. Assessment scores will be determined and presented in an action plan being prepared for the 100-D/DR Reactor Area by ERC cultural resource staff. These assessments will accelerate cultural resource reviews and clearances, which are required of all Hanford Site projects involving ground disturbing activities, as mandated in the Hanford Cultural Resource Management Plan (Chatters 1989).

The following waste sites in the 100-DR-1 Operable Unit have high cultural resource sensitivity, so any work done involving these sites should include cultural resource staff to incorporate cultural resource concerns into remedial action decision making:

- 116-D-7 (107-D) Retention Basin
- 116-DR-9 (107-DR) Retention Basin
- 116-DR-1 Liquid Effluent Disposal Trench
- 116-DR-2 Liquid Effluent Disposal Trench
- 116-D-5
- 116-DR-5
- 126-D-2
- Process Effluent Pipelines
- 107-D Sludge Trenches
- 107-DR Sludge Trenches.

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2.2.4 Summary

The potential influence of remedial actions on the resources described in the preceding subsections are considered during the analysis of Remedial Alternatives conducted in Sections 5.0 and 6.0 of the Process Document and Sections 5.0, 6.0, and 7.0 of this 100-DR-1 FFS. Other issues, such as potential transportation and socioeconomic impacts are also discussed in Sections 3.3 and 5.2 of the Process Document. The assessment of potential impacts in the Process Document are consistent with the potential impacts anticipated as a result of remediating the individual waste sites at the 100-DR-1 Operable Unit. Mitigation measures, as discussed in Section 5.2.2 of the Process Document, will be developed during the conceptual and preliminary design of the selected Remedial Alternative to avoid or minimize impacts on physical, biological, and cultural resources.

2.3 LIMITED FIELD INVESTIGATION

The LFI is an integral part of the RI/FS process and is based on Hanford Site-specific agreements discussed in the *Hanford Federal Facility Agreement and Consent Order* (Fourth Amendment) (Ecology et al. 1994), the *Hanford Site Risk Assessment Methodology* (DOE-RL 1995), the *RCRA Facility Investigation/Corrective Measures Study Work Plan for the 100-DR-1 Operable Unit* (DOE-RL 1992a), and the *Hanford Past-Practice Strategy (HPPS)* (DOE-RL 1991). The HPPS emphasizes initiating and completing waste site cleanup through interim actions.

The primary purpose of the LFI at the 100-DR-1 Operable Unit (DOE-RL 1993b) was to collect sufficient data to recommend which sites should remain as candidates for interim remedial measures (IRM). Sites that are not recommended for an IRM will be addressed later during the final remedy selection process for the entire 100 Area. The data gathered in the LFI are also used to evaluate Remedial Alternatives in this FFS.

A Qualitative Risk Assessment (QRA) was performed as part of the LFI, and determined the principal risk drivers at the 100-DR-1 Operable Unit. Another purpose of the 100-DR-1 QRA (WHC 1993) was to qualitatively evaluate human health and environmental exposure scenarios to help determine which waste sites within the 100-DR-1 Operable Unit were candidates for IRM. The QRA evaluated risks for a predefined set of human and environmental exposure scenarios, and is not intended to replace or be a substitute for a baseline risk assessment.

The QRA considered only two human health exposure scenarios (frequent- and occasional-use) with four pathways (soil ingestion, fugitive dust inhalation, inhalation of volatile organics from soil, and external radiation exposure), and an ecological exposure scenario based on ingestion of plants by the Great Basin pocket mouse.

For the human health risk assessment, frequent- and occasional-use exposure scenarios were evaluated to provide bounding estimates of risk consistent with the residential and recreational exposure scenarios presented in the *Hanford Site Risk Assessment Methodology* (DOE-RL 1995). Currently there are no such land uses in the 100-DR-1 Operable Unit.

The estimated risks associated with carcinogenic contaminants at 100-DR-1 were grouped into four categories based on lifetime incremental cancer risk (ICR):

- high - ICR $>1 \times 10^{-2}$
- medium - ICR between 1×10^{-4} and 1×10^{-2}
- low - ICR between 1×10^{-6} and 1×10^{-4}
- very low - ICR $<1 \times 10^{-6}$.

A frequent-use scenario was evaluated in the year 2018 to ascertain potential future risks associated with each waste site after additional radionuclide decay. For the current occasional-use scenario, the effect of radiation shielding by the upper 2 m (6 ft) of soil on the external exposure risk at each waste site also was evaluated.

The ecological risk assessment evaluated contaminant uptake by the Great Basin pocket mouse. The mouse was used as an indicator receptor because it is common at the Hanford Site, its home range is comparable to the size of most waste sites, and it lives in close proximity to the contaminants in the soil. Ecological risks were defined by estimating the amount of contaminants received through ingestion of food, and then calculating an environmental hazard quotient. An environmental hazard quotient greater than one (unity) indicates that the contaminant poses a risk to individual mice.

The results of the LFI/QRA were used to select the sites where IRM should be evaluated. If an IRM is not justified, the site will be subject to further investigation and/or remediation under the site-wide RI/FS process. The LFI report for the 100-DR-1 Operable Unit described the field sampling program, identified the constituent concentrations at each of the sites, presented the data analysis, and discussed the risk assessment conclusions for the operable unit (DOE-RL 1993b).

Based on the LFI/QRA, waste sites at the 100-FR-1 Operable Unit were retained as IRM candidates if:

- The site posed a medium or high incremental cancer risk to humans under the occasional-use scenario

- The site contained noncarcinogenic contaminants that exceeded a human health hazard quotient of 1.0

- The site contained contaminants that posed a risk to the Great Basin pocket mouse (Environmental Hazard Quotient [EHQ] greater than 1.0)

- The conceptual exposure model could not be completed because of insufficient data

- The site had contaminants at levels that exceeded applicable or relevant and appropriate requirements (ARAR) (see Appendix C of the Process Document)

- The site had a probable current impact on groundwater, based on comparing onsite contaminant concentrations to groundwater protection criteria.

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The LFI also assumed that solid waste burial grounds are IRM candidate sites regardless of the above criteria. The IRM candidacy review conducted during the LFI evaluation retained 22 waste sites and three burial grounds as IRM candidates (Table G2-1).

Although the outfall structures at the 100-DR-1 Operable Unit were determined to be IRM candidate sites in the LFI, they have been recently designated for an expedited response action, in conjunction with the effluent pipelines at the operable unit. The *100 Area River Effluent Pipelines Expedited Response Action Proposal* (DOE-RL 1994a) states that the 100 Area outfall structures will be addressed concurrently with the river pipelines. The 116-D-5 and 116-DR-5 outfall structures are therefore, not addressed further in this FFS. Also, the sites such as 130-D-1 gasoline storage tank, 126-D-2 solid waste landfill and 103-D fuel element storage building are excluded from further consideration because they have incomplete conceptual models.

The conclusions drawn from the LFI and QRA studies were used solely to determine IRM candidacy for high-priority waste sites and solid waste burial grounds within the 100-DR-1 Operable Unit. While this FFS report relies on the data presented in the LFI/QRA, the conclusions drawn in this FFS are based on the analyses of the Remedial Alternatives in Sections 5.0 and 6.0 of the Process Document, Sections 4.0 and 5.0 in the Sensitivity Analysis (Appendix D), and this FFS (Appendix G).

2.4 DEVELOPMENT OF WASTE-SITE PROFILES

Waste-site profiles have been developed for each of the 20 IRM candidate sites within the 100-DR-1 Operable Unit. These 20 IRM candidate sites were selected from 30 high-priority waste sites (Table G2-1) within the 100-DR-1 Operable Unit during the LFI study (DOE-RL 1993b). The individual site profiles were developed using radiological data from Dorian and Richards (1978), data obtained during the 1992 LFI, and information acquired during decontamination and decommissioning activities. When site-specific data were unavailable, data from an analogous site were assumed to be the most appropriate information for describing the conditions at the 100-DR-1 IRM site, and developing its waste-site profile.

2.4.1 Site Descriptions

The first step in developing the individual waste-site profiles was to prepare a basic site description of each IRM candidate site (Table G2-2). This included listing the name of the site, describing its use during the operation of the D and DR Reactors, describing its physical characteristics (the size and structural material), and determining which one of the waste site groups the individual waste site belonged in. The waste-site groups are listed and described in Section 3.0 of the Process Document.

2.4.2 Refined Contaminants of Potential Concern

To develop the individual waste-site profiles, another activity was determining what contaminants were present at each waste site that posed a risk to humans, biological receptors (plants and animals), and groundwater quality. These so-called "refined COPC" are the risk drivers at the site and represent the contaminants that have to be remediated. The refined COPC were identified by starting with the list of COPC developed during the LFI and screening these contaminants against more stringent risk criteria.

The COPC (from the LFI) are defined as those contaminants that are known to occur within the operable unit or waste site, and were present at concentrations that exceeded natural background levels or conservative human risk criteria (ICR > 10^{-7} or HQ > 1.0). For example, if strontium-90 was present at soil concentrations above 193 pCi/g, it presented an incremental cancer risk greater than 10^{-7} and was considered a COPC. If strontium-90 concentrations were below this level the concentrations were considered to be below levels requiring further evaluation, and the contaminant was not a COPC.

The refined COPC for each IRM candidate site at the 100-DR-1 Operable Unit were identified by comparing the concentrations of the COPC to the preliminary remediation goals (PRG) developed in Section 2.0 and Appendix A of the Process Document. If the maximum COPC concentration at the waste site exceeded any of the PRGs, then that contaminant was considered a refined COPC. There can be one to several refined-COPC at each site, and the number and types of refined-COPC are used to help determine which Remedial Alternatives may be appropriate at the site. The derivation of the PRGs is described in Appendix A of the Process Document. The PRG represents the maximum concentration of a contaminant that would not exceed an acceptable human health or ecological risk level, or would not exceed the groundwater protection criteria. Table G2-3 presents the PRGs that were developed in the Process Document. These preliminary remediation goals were never set at concentrations that were below natural background concentrations, to preclude trying to remediate naturally existing constituents in soils. Also, if the risk-based PRG was less that the laboratory required quantification/detection limit for that particular contaminant, then the quantification/detection limit was used as the PRG (for example, the PRG for carbon-14 was set at 50 pCi/g even though the groundwater protection PRG is 18 pCi/g, Table G2-3).

Two or more PRGs were determined for each COPC identified in the LFI, as shown in Table G2-3. All COPC had a PRG that represented a concentration protective of groundwater, and almost all COPC had a PRG based on human health risks assuming a recreational exposure scenario. The PRGs for the carcinogenic radionuclides and chemicals represented the soil concentration that would pose an incremental cancer risk of one in a million. The human health PRGs for noncarcinogenic chemicals represented the concentration that would result in a hazard quotient of 0.1. For a given contaminant, the most stringent PRG was used, and the PRG were applied at two different depth strata depending on whether human and biological receptors would be exposed or protection of groundwater is the main factor. For example, for cobalt-60 the most stringent PRG is the one in a million incremental cancer risk level (soil concentration of 17.5 pCi/g). This PRG (17.5) is applicable at the 0 to 3 m (0 to 10 ft) depth strata because (1) humans are exposed to contaminants within the 0 to 1 m (0 to 3 ft) strata (assuming a recreational exposure scenario) and (2) the human health-based PRG were used at depth strata where animals and plants (0 to 3 m [0-10 ft]) are exposed because there is no ecological-based PRG available for cobalt-60 (i.e., the human health PRG is used as default values). It was assumed that there were no exposure pathways that would link contaminants below 3 m (10 ft) to humans,

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animals, or plants; therefore, the groundwater protection PRG (1292 pCi/g) is applied at the >3 m (10 ft) depth strata. The groundwater protection PRG is also applied to the 0 to 3 m (0 to 10 ft) depth strata if it is more stringent than the human-risk PRGs.

To identify the refined COPC at each waste site, several assumptions and protocols were used to compare the COPC to the PRGs. These include the following:

- The soils within the waste site were divided into two depth strata, corresponding to the depth strata that the human and biological receptors and groundwater could be exposed to. This approach is discussed in detail in Section 2.0 and Appendix A of the Process Document.

- At each waste site, the maximum concentration of each contaminant (COPC) within each stratum was identified. The maximum concentration was taken from either the LFI data set or the Dorian and Richards (1978) data set.

- The historical data set (Dorian and Richards) was modified to account for radioactive decay between 1978 and 1992, so it was consistent with the LFI data set collected in 1992.

- If a sample was collected at the boundary between two strata (i.e., at 1 m [3 ft]) the data from that sample were applied to the shallower stratum (i.e., the 1 to 2 m [3 to 6 ft] strata).

- Historical or LFI data reported within a range (e.g., 4.4 to 4.8 m [14.5 to 16 ft]) were applied to two depth strata if appropriate (e.g., the 3 to 4.5 [10 to 15 ft] and 4.5 to 6 m [15 to 20 ft] ranges).

- The nickel-63 concentrations reported by Dorian and Richards (1978) may have been analyzed using a surrogate. Therefore, the concentrations reported in this FFS may not be an accurate representation of the actual concentration at the waste site. For the purpose of this FFS, the nickel-63 concentrations reported by Dorian and Richards were used as the best available estimate.

- Total uranium concentrations were reported by Dorian and Richards (1978) rather than specific isotopes. For the purpose of this FFS, the total concentrations were considered to be uranium-238 because uranium-238 was determined to be the major risk contributor of the uranium isotopes during the QRA.

The screening process that compares the COPC to PRG and identifies the refined COPC results in the identification of the contaminants that must be addressed by remedial action at the given IRM candidate site. Tables G2-4 through G2-11 present the PRG screening for the eight IRM candidate sites at the 100-DR-1 Operable Unit that have analytical data, Table G2-12.

2.4.3 Waste-site Profiles

The waste-site profiles characterizing each individual waste site are presented in Table G2-12. Each profile includes the extent of contamination (how much soil may have to be excavated or what area may have to be capped), the depth of contamination, the media (i.e., soil) or material at the waste site, a list of refined COPCs at the waste site, and the maximum concentration observed for each refined-COPC. The waste-site profiles also state if the contaminant concentrations exceed the reduced infiltration concentration). The reduced infiltration concentration is the soil concentration that is considered protective of groundwater under the assumption that hydraulic infiltration is limited by a surface barrier over the wastes. The reduced infiltration concentrations are presented in Table G2-13; their derivation is discussed in Appendix A of the Process Document.

The waste-site profiles serve several purposes. First, they contain information needed to compare each waste site at 100-DR-1 to the Waste Site Groups developed in Section 3.0 of the Process Document. The profile information is also used to compare the site characteristics of each waste site with the applicability criteria developed in Section 4.0 of the Process Document, to help determine which Remedial Alternatives are or are not appropriate for that site. The area, depth, and volume of contamination is used to determine how much soil may have to be excavated, treated, capped, etc.; this has a direct bearing on time and costs for remedial action. The information in the profiles is explained more in the following paragraphs, and the actual profiles are presented in Table G2-12.

- Extent of Contamination - This includes the volume, length, width, area, and thickness of the contaminated media. The volume estimates performed for each site are presented in Attachment 1 of this document. Volume, length, width, and area do not necessarily impact the determination of appropriate Remedial Alternatives; however, they are important considerations for developing costs and estimating the time required for remedial actions. Thickness of the contaminated lens impacts the implementability of In Situ actions such as vitrification, which has a limited vertical extent of influence.

- Contaminated Media/Material - Contaminated media and material located at the site are determined and described. Structural materials such as steel, concrete, and wooden timbers influence the applicability of Remedial Alternatives, as well as equipment needed for actions such as removal. The presence of solid wastes will influence material handling considerations and may require Remedial Alternatives that are different than alternatives for sites with just contaminated soil.

- Refined COPC/Maximum Concentrations - Refined COPC for a site are determined as discussed in Section 2.4.2. The associated maximum concentration for each refined COPC is the highest concentration detected at the site. Refined COPC may influence the applicability of Remedial Alternatives. For example, the presence of certain radioactive contaminants may allow natural decay to be considered in determining appropriate remedial actions. The presence of organic contaminants may require that enhancements, such as thermal desorption, be added to a treatment system.

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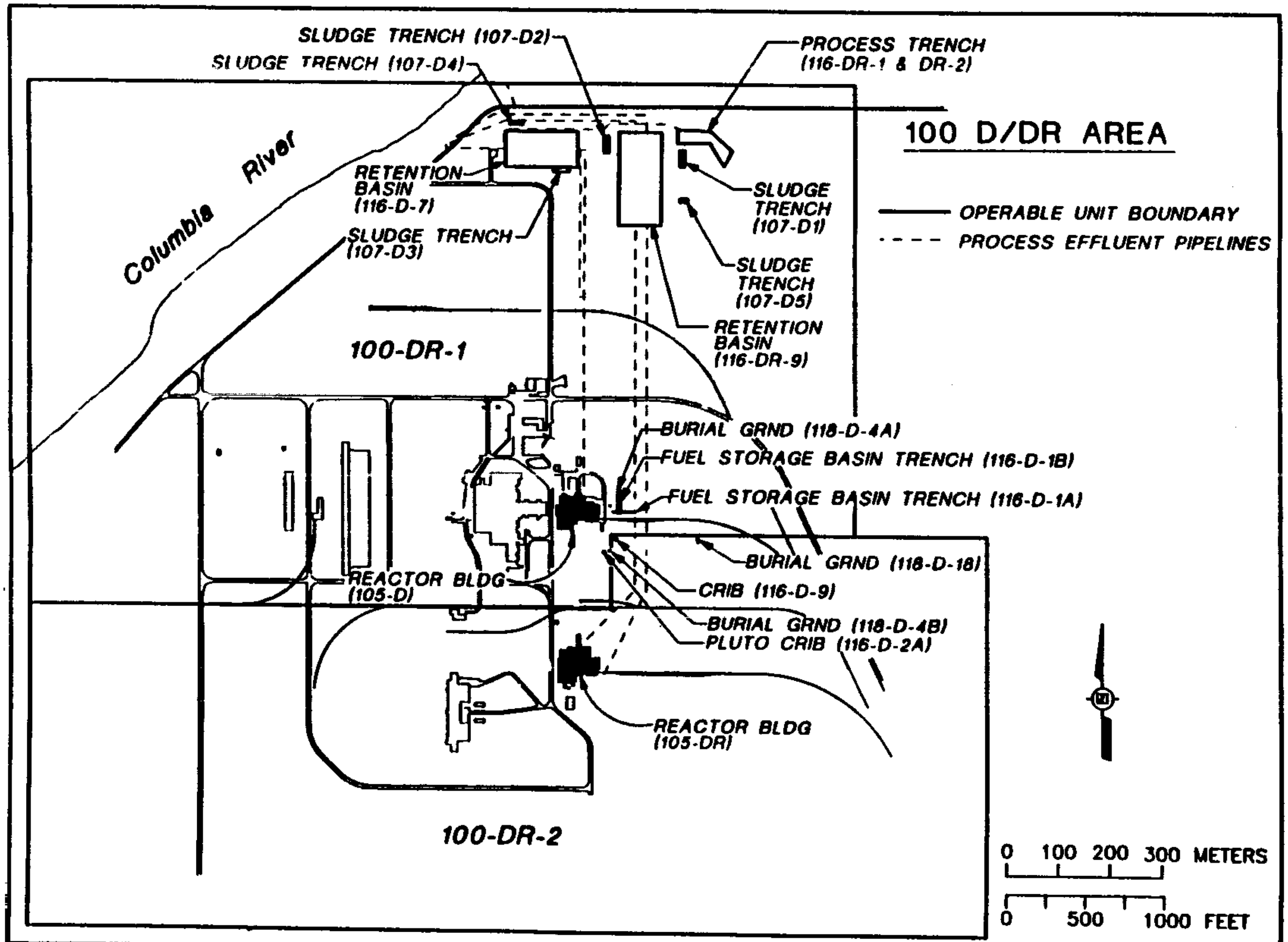
- Reduced Infiltration Concentration - The reduced infiltration concentration is a level that is considered protective of groundwater under a scenario where hydraulic infiltration is limited by the application of a surface barrier. The maximum refined COPC concentration detected is compared to the allowable reduced infiltration concentration. Exceedance of the reduced infiltration concentrations indicates that containment alternatives using a surface cap may not prevent contaminants from leaching into the groundwater below the site.

The following Section 3.0 on application of the plug-in approach describes the use of the site profiles during the feasibility study process.



SOURCE: DOE/RL 94-64

ITH:JJA:P711B-A2

Figure G2-1. 100-DR-1 Operable Unit Map.

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Table G2-1. IRM Recommendations from the 100-DR-1 LFI[a].

Waste Site	Qualitative Risk Assessment		Conceptual Model	Exceeds ARAR	Probable Current Impact on Groundwater	Potential for Natural Attenuation by 2018	IRM Candidate yes/no
	Low-frequency scenario	EHQ > 1					
116-D-1A	medium	no	adequate	no	yes	yes	yes
116-D-1B	medium	no	adequate	no	yes	yes	yes
116-D-6	low	no	adequate	no	no	yes	no
116-D-7	high	yes	adequate	no	yes	no	yes
116-DR-9	high	yes	adequate	no	yes	no	yes
116-DR-1	medium	no	adequate	no	yes	yes	yes
116-DR-2	medium	no	adequate	no	yes	yes	yes
116-D-2A	low	no	adequate	no	yes	yes	yes
116-D-9	medium	-	adequate	no	yes	yes	yes
132-D-3	low	-	adequate	no	no	yes	yes
116-D-5	medium	no	adequate	no	no	yes	yes
116-DR-5	medium	-	adequate	no	no	yes	yes
116-D-3	very low	no	adequate	no	no	yes	no
116-D-4	very low	no	adequate	no	no	yes	no
130-D-1	low	no	incomplete*	no	no	yes	yes
108-D	low	no	adequate	no	no	yes	no
Sodium Dichromate Tanks	low	no	adequate	no	no	yes	no
103-D	low	-	incomplete*	no	no	yes	yes
126-D-2	medium	-	incomplete*	unknown	no	yes	yes
115-D (132-D-1)	low	-	adequate	unknown	no	unknown	yes
117-D (132-D-2)	low	-	adequate	unknown	no	unknown	yes
Process Effluent Pipelines	medium	-	adequate	unknown	yes	unknown	yes
107-D Sludge Trenches	high	no	adequate	unknown	yes	no	yes
107-DR Sludge Trenches	high	yes	adequate	unknown	yes	no	yes
118-D-4A, 4B, 18 Burial Grounds							yes

[a]This table is from the 100-DR1 LFI report (DOE/RL 1993b)

- \- Not rated by the qualitative ecological risk assessment
- * Data needed concerning nature and vertical extent of contamination, site remains an IRM candidate until data are available. Therefore, not addressed in this FFS.
- ARAR Applicable or relevant and appropriate, specifically the Washington State *Model Toxics Control Act* Method B concentration values for soils
- EHQ Environmental Hazard Quotient calculated by the qualitative ecological risk assessment
- IRM interim remedial measure

Table G2-2. 100-DR-1 Site Description.
(page 1 of 2)

Site#/Name (Alias)	Use	Physical Description	Data Source
116-D-7 (107-D Retention Basin)	Received cooling water effluent from D Reactor and decontamination waste; discharged mostly to the Columbia River; probably received ruptured fuel element waste; much leakage from basin to soil.	Retention basin Reinforced concrete single containment. 142.3 x 70.1 x 7.3 m (466 x 230 x 24 ft) deep	LFI, historical
116-DR-9 (107-DR Retention Basin)	Received cooling water effluent from DR Reactor; probably received ruptured fuel element waste; may have been much leakage to soils from basins.	Retention basin Reinforced concrete single containment. 182.9 x 83.2 x 6.1 m (20 x 273 x 20 ft) deep	LFI, historical
116-DR-1/DR-2 (107-DR Liquid Effluent Disposal Trench #1 and #2)	Received 40 million liters effluent overflow from the 107-D and 107-DR retention basins at times of high activity because of fuel element failure.	Trench Unlined Variable dimensions	LFI, historical
107-D/DR Sludge Disposal Trench #1	Received sludge from D retention basins when they were dredged for repairs.	Trench 32 x 9.1 x 3.1 m (105 x 30 x 10 ft) deep	No analytical data
107-D/DR Sludge Disposal Trench #2	Received sludge from D retention basins when they were dredged for repairs.	Trench 32 x 9.1 x 3.1 m (105 x 30 x 10 ft) deep	No analytical data
107-D/DR Sludge Disposal Trench #3	Received sludge from D retention basins when they were dredged for repairs.	Trench 32 x 9.1 x 3.1 m (105 x 30 x 10 ft) deep	No analytical data
107-D/DR Sludge Disposal Trench #4	Received sludge from D retention basins when they were dredged for repairs.	Trench 25.9 x 6.1 x 3.1 m (85 x 20 x 10 ft) deep	No analytical data
107-D/DR Sludge Disposal Trench #5	Received sludge from D retention basins when they were dredged for repairs.	Trench 15.2 x 6.1 x 3.1 m (49.8 x 20 x 10 ft) deep	No analytical data
116-D-1A (105-D Fuel Storage Basin Trench #1)	Received contaminated water from 105-D fuel storage basin (20,000 liters).	Trench Unlined 39.6 x 3.1 x 1.8 m (129.9 x 10 x 5.9 ft) deep	LFI, historical
116-D-1B (105-D Fuel Storage Basin Trench #2)	Received contaminated water from 105-D fuel storage basin (eight million liters).	Trench Unlined 30.5 x 3.1 x 4.6 m (100 x 5.9 x 15.09 ft) deep	LFI, historical
116-D-2A (105-D Pluto Crib)	Received 4,000 liters effluent water from tubes following fuel cladding failures. In 1956, site was covered to grade with clean soil, sampling did not determine contamination, however, may not have found correct location of crib.	Crib/french drain Gravel filled. 3.1 x 3.1 x 3.1 m (10 x 10 x 10 ft) deep	LFI
116-D-9 Confinement Seal Crib (117-D-Crib)	Received 420,000 liters of waste.	Crib/french drain Gravel filled. 3.1 x 3.1 x 3.1 m (10 x 10 x 10 ft) deep	LFI

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Table G2-2. 100-DR-1 Site Description.
(page 2 of 2)

Site#/Name (Alias)	Use	Physical Description	Data Source
Pipelines	Transported reactor cooling water effluent, decontamination wastes, and/or reactor confinement seal pit drainage to retention basins and disposal trenches.	Process effluent pipelines Total length approximately 4,021 m (13,193 ft); pipe diameter varies; depth below surface varies.	historical
118-D-4A Burial Ground	Received radioactive and nonradioactive solid waste.	Burial ground 57.9 x 18.3 x 6.1 m (190 x 60 x 20 ft) deep	No analytical data
118-D-4B Burial Ground	Received radioactive and nonradioactive solid waste.	Burial ground 32 x 7.3 x 3.7 m (105 x 24 x 12 ft) deep	No analytical data
118-D-18 Burial Ground	Received radioactive and nonradioactive solid waste.	Burial ground 24.4 x 12.2 x 6.1 m (80 x 40 x 20 ft) deep	No analytical data
132-D-1 (115-D Gas Recirculation Building)	Recirculated cover gases around reactor core.	D&D facility Demolished reinforced concrete. 51.2 x 29.9 x 3.4 m (168 x 98.1 x 11.1 ft) tall	D&D (Dement 1986)
132-D-2 (117-D Exhaust Air Filter)	Received reactor building exhaust gas.	D&D facility Demolished reinforced concrete. Building: 18 x 11.9 x 8.2 m (59 x 39 x 26.9 ft) high Tunnels: 58 m (190 ft) long	D&D (Beckstrom and Loveland 1986)
132-D-3 (1608-D Effluent Pumping Facility)	Received water from D Reactor fuel storage basin overflows, also contained decontamination chemicals.	D&D facility 6.1 x 6.1 x 9.8 m (20 x 20 x 31.9 ft) deep	D&D, LFI (REF)

D&D decontamination and decommissioning
LFI limited field investigation

Table G2-3. Preliminary Remediation Goals.

	HUMAN-HSRAM (a,b)		PROTECTION of GROUNDWATER (a,c)	BACKGROUND (d,e)	CRQL/CRDL (f) or as noted		ZONE SPECIFIC PRG	
	TR = 1E-06	HQ = 0.1					1 (g) 0-10 ft.	2 (h) >10 ft
RADIONUCLIDES (pCi/g)								
Am-241	76.9	N/A	31	N/C	1		31	31
C-14	44,200	N/A	18	N/C	50		50	50
Cs-134	3,460	N/A	517	N/C	0.1	(d)	517	517
Cs-137	5.68	N/A	775	1.8	0.1	(d)	5.68	775
Co-60	17.5	N/A	1,292	N/C	0.05	(d)	17.5	1,292
Eu-152	5.96	N/A	20,667	N/C	0.1		5.96	20,667
Eu-154	10.6	N/A	20,667	N/C	0.1	(d)	10.6	20,667
Eu-155	3,080	N/A	103,000	N/C	0.1	(d)	3,080	103,000
H-3	2,900,000	N/A	517	N/C	400		517	517
K-40	12.1	N/A	145	19.7	4	(d)	19.7	145
Na-22	545	N/A	207	N/C	4	(i)	207	207
Ni-63	184,000	N/A	46,500	N/C	30		46,500	46,500
Pu-238	87.9	N/A	5	N/C	1	(d)	5	5
Pu-239/240	72.8	N/A	4	0.035	1	(d)	4	4
Ra-226	1.1	N/A	0.03	0.98	0.1	(d)	0.98	0.98
Sr-90	1,930	N/A	129	0.36	1	(d)	129	129
Tc-99	28,900	N/A	26	N/C	15		26	26
Th-228	7,260	N/A	0.1	N/C	1	(j)	1	1
Th-232	162	N/A	0.01	N/C	1		1	1
U-233/234	165	N/A	5	1.1	1	(d)	5	5
U-235	23.6	N/A	6	N/C	1	(d)	6	6
U-238 (k)	58.4	N/A	6	1.04	1	(d)	6	6
INORGANICS (mg/kg)								
Antimony	N/A	167	0.002	N/C	6		6	6
Arsenic	16.2	125	0.013	9	1	(e)	9	9
Barium	N/A	29,200	258	175	20	(e)	258	258
Cadmium	1,360	417	0.775	N/C	0.5		0.775	0.775
Chromium VI	204	2,086	0.026	28	1	(e)	28	28
Lead	N/C	N/C	8	14.9	0.3	(e)	14.9	14.9
Manganese	N/A	2,086	13	583	1.5	(e)	583	583
Mercury	N/A	125	0.31	1.3	0.02	(e)	1.3	1.3
Zinc	N/A	100000 (c)	775	79	2	(e)	775	775
ORGANICS (mg/kg)								
Aroclor 1260 (PCB)	4.34	N/A	1.37	<0.033	0.033	(e)	1.37	1.37
Benzo(a)pyrene	5	N/A	5.68	<0.330	0.330	(e)	5	6
Chrysene	N/A	N/A	0.01	<0.330	0.330	(e)	0.330	0.330
Pentachlorophenol	300	N/A	0.27	<0.8	0.8	(e)	0.8	0.8

TR=Target Risk; HQ= Hazard Quotient; N/A=Not Applicable; N/C=Not calculated; PRG=Preliminary Remediation Goal
(a) Risk-based numbers are expressed to to one significant figure.
(b) Occasional Use Scenario
(c) Based on Summer's Model (EPA 1989b)
(d) Status Report, Hanford Site Background: Evaluation of Existing Soil Radionuclide Data (Letter #008106)
(e) Hanford Site Background: Part 1, Soil Background for Nonradioacitve Analytes, DOE/RL-92-24, Rev. 2.
(f) Based on 100-BC-5 OU Work Plan QAPP (DOE-RL 1992)
(g) PRGs are established to be protective of groundwater, human and ecological receptors. The screening process used to establish PRGs for zone 1 are discussed in section 2.3 of this document.
(h) PRGs are established to be protective of groundwater. The screening process used to establish PRGs for zone 2 are ciscussed in section 2.3 of this document.
(i) Based on gross beta analysis
(j) Detection limit assumed to be same as Th-232
(k) Includes total U if no other data exist
(l) Value calculated exceeds 1,000,000 ppm therefore use 100,000 ppm as default

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Table G2-4. 116-D-7 Refined Contaminants of Potential Concern Based on Occasional Land Use Scenario and Protection of Groundwater.

116-D-7	Zone 1 (a)						Zone 2 (b)												Refined
	0 - 3 ft		3 - 6 ft		6 - 10 ft		10 - 15 ft		15 - 20 ft		20 - 25 ft		25 - 30 ft		30 - 35 ft		35 - 40 ft		COPC
	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Summary
RADIONUCLIDES (pCi/g)																			
Am-241		NO	2.80E-03	NO	2.80E-03	NO		NO		NO		NO	1.20E-02	NO	1.20E-02	NO	3.20E-03	NO	
C-14	5.89E+01	YES	4.19E+02	YES	4.30E-01	NO		NO		NO		NO		NO		NO		NO	YES
Cs-134	1.33E+00	NO	7.82E+00	NO	1.79E-02	NO	6.58E-02	NO	1.75E-04	NO	2.44E-03	NO	1.70E-03	NO	1.43E-04	NO		NO	
Cs-137	1.32E+03	YES	1.04E+03	YES	3.39E+01	YES	2.08E+01	NO	1.87E+01	NO	3.46E+01	NO	3.11E+01	NO	1.38E+01	NO		NO	YES
Co-60	3.05E+03	YES	8.30E+02	YES	6.95E+01	YES	8.17E+01	NO	2.56E+01	NO	1.46E+02	NO	9.03E+01	NO	1.07E+01	NO		NO	YES
Eu-152	2.96E+04	YES	7.96E+03	YES	2.91E+02	YES	2.78E+02	NO	9.72E+01	NO	2.61E+02	NO	1.24E+02	NO	2.74E+01	NO		NO	YES
Eu-154	9.94E+03	YES	5.68E+03	YES	6.53E+01	YES	7.10E+01	NO	2.30E+01	NO	5.68E+01	NO	2.36E+01	NO	5.40E+00	NO		NO	YES
Eu-155	2.03E+02	NO	6.63E+02	NO	3.10E+00	NO	5.46E+00	NO	4.07E-01	NO	2.89E+00	NO	7.17E-01	NO	9.95E-02	NO		NO	
H-3	1.74E+01	NO	1.98E+04	YES	6.08E+00	NO	7.29E+00	NO	2.19E+00	NO	1.01E+01	NO	6.08E+00	NO	1.90E+00	NO		NO	YES
K-40		NO	8.71E+00	NO	8.71E+00	NO		NO		NO		NO	1.25E+01	NO	1.58E+01	NO	1.58E+01	NO	
Na-22		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Ni-63	1.97E+04	NO	1.43E+04	NO		NO		NO		NO		NO		NO		NO		NO	
Pu-238	4.14E+00	NO	4.14E+00	NO		NO	3.52E-03	NO		NO	2.20E-03	NO		NO	4.23E-01	NO		NO	
Pu-239/240	2.10E+02	YES	2.90E+02	YES	8.30E-01	NO	1.20E+00	NO	1.50E-01	NO	2.30E+00	NO	7.70E-01	NO	1.30E+01	YES	5.60E-03	NO	YES
Ra-226		NO		NO		NO		NO		NO		NO	5.85E-01	NO	7.49E-01	NO	7.49E-01	NO	
Sr-90	3.73E+02	YES	2.24E+01	NO	2.92E+00	NO	1.16E+00	NO	1.61E+00	NO	2.31E+00	NO	1.90E+00	NO	1.09E+00	NO	5.20E-01	NO	YES
Tc-99		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Th-228		NO	5.38E-01	NO	5.38E-01	NO		NO		NO		NO	4.49E-01	NO	5.60E-01	NO	5.60E-01	NO	
Th-232		NO		NO		NO		NO		NO		NO		NO		NO		NO	
U-233/234		NO		NO		NO		NO		NO		NO		NO		NO		NO	
U-235		NO	4.20E-03	NO	4.20E-03	NO		NO		NO		NO	4.60E-03	NO	4.60E-03	NO	1.50E-02	NO	
U-238 (c)	[illegible]	NO	3.20E+00	NO	7.40E-01	NO	4.30E-01	NO	2.40E-01	NO	[illegible]	NO	3.60E-01	NO	1.80E-01	NO	1.80E-01	NO	
INORGANICS (mg/kg)																			
Antimony		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Arsenic		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Barium		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Cadmium		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Chromium VI		NO	5.16E+01	YES	5.16E+01	YES		NO		NO		NO	3.49E+01	YES		NO		NO	YES
Lead		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Manganese		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Mercury		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Zinc		NO		NO		NO		NO		NO		NO		NO		NO		NO	
ORGANICS (mg/kg)																			
Aroclor 1260 (PCB)		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Benzo(a)pyrene		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Chrysene		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Pentachlorophenol		NO		NO		NO		NO		NO		NO		NO		NO		NO	

* Maximum concentrations are screened against the PRG (preliminary remediation goal). "Yes" if the value exceeds the PRG. "No" if the value is below the PRG.
The COPCs (contaminants of potential concern) are refined based on the soil concentration and the PRG.
A blank under "Max" means either no information is available or the constituent was not detected.

(a) PRGs are established to be protective of groundwater, human and ecological receptors.
(b) PRGs are established to be protective of groundwater.
Sources:
Dorian, J.J. and V.R. Richards, 1978, Tables 2, 7, 33, 43, 48, 50, 51.
DOE-RL 1993d, Tables 3, 13, 14, 15, 16.

Table G2-5. 116-DR-9 Refined Contaminants of Potential Concern Based on Occasional Land Use Scenario and Protection of Groundwater.

116-DR-9	Zone 1 (a)						Zone 2 (b)										Refined COPC
	0 - 3 ft		3 - 6 ft		6 - 10 ft		10 - 15 ft		15 - 20 ft		20 - 25 ft		25 - 30 ft		30 - 35 ft		
	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Summary
RADIONUCLIDES (pCi/g)																	
Am-241		NO	1.00E-02	NO	2.00E-02	NO	1.50E-02	NO	8.60E-03	NO	1.30E-02	NO	5.00E-01	NO	1.30E-03	NO	
C-14	1.80E+02	YES	3.00E-01	NO	5.00E-01	NO	3.00E-01	NO	2.20E-01	NO		NO	6.00E-01	NO	3.40E-01	NO	YES
Cs-134	1.24E+00	NO	5.50E-04	NO	4.00E-02	NO	4.00E-02	NO	1.40E-04	NO		NO	3.00E-02	NO	3.00E-02	NO	
Cs-137	3.25E+03	YES	2.98E+02	YES	9.69E+02	YES	1.94E+01	NO	2.56E+00	NO		NO	3.00E-02	NO	2.36E-01	NO	YES
Co-60	2.07E+03	YES	4.27E+01	YES	6.22E+01	YES	6.83E+00	NO	5.49E-02	NO		NO	3.00E-02	NO	2.00E-02	NO	YES
Eu-152	1.11E+04	YES	1.64E+02	YES	2.61E+02	YES	9.28E+00	NO	4.15E-01	NO		NO	7.51E-02	NO		NO	YES
Eu-154	3.98E+03	YES	3.86E+01	YES	5.96E+01	YES	2.22E+00	NO	5.96E-02	NO		NO	7.35E-02	NO		NO	YES
Eu-155	2.46E+01	NO	1.71E+00	NO	3.21E+00	NO	2.00E-01	NO	2.25E-02	NO		NO	2.46E-02	NO		NO	
H-3	5.67E+00	NO	2.03E+00	NO	3.32E+00	NO	2.31E+00	NO	2.31E+00	NO		NO		NO		NO	
K-40		NO	8.10E+00	NO	8.22E+00	NO	8.71E+00	NO	1.13E+01	NO	1.34E+01	NO	1.47E+01	NO	1.28E+01	NO	
Na-22		NO		NO		NO	1.03E-01	NO		NO		NO		NO		NO	
Ni-63	8.50E+03	NO		NO		NO		NO		NO		NO		NO		NO	
Pu-238	9.69E-01	NO		NO		NO		NO		NO		NO		NO		NO	
Pu-239/240	6.50E+01	YES	1.00E+00	NO	2.10E+00	NO	2.40E+00	NO	1.30E-04	NO	1.30E-03	NO	5.00E-01	NO	1.90E-03	NO	YES
Ra-226		NO	1.10E+00	YES	8.19E-01	NO	8.02E-01	NO	7.65E-01	NO	8.12E-01	NO	8.13E-01	NO	1.23E+00	YES	YES
Sr-90	1.70E+02	YES	3.80E+00	NO	6.72E+00	NO	2.50E+00	NO	1.10E+00	NO	6.60E-01	NO	1.09E+00	NO	7.70E-01	NO	YES
Tc-99		NO	1.30E+00	NO		NO	6.60E-01	NO		NO		NO	1.00E+00	NO	2.40E-01	NO	
Th-228		NO	3.80E-01	NO	4.76E-01	NO	4.75E-01	NO	5.83E-01	NO	5.62E-01	NO	5.75E-01	NO	6.90E-01	NO	
Th-232		NO		NO		NO		NO		NO		NO		NO		NO	
U-233/234		NO		NO	1.60E-01	NO	1.80E-01	NO		NO		NO		NO		NO	
U-235		NO	4.40E-03	NO	8.00E-03	NO	1.10E-02	NO	2.20E-02	NO	6.70E-03	NO	1.00E-02	NO	5.60E-03	NO	
U-238 (k)	9.00E-01	NO	5.10E-01	NO	6.60E-01	NO	3.40E-01	NO	2.00E-01	NO	1.30E-01	NO	2.00E-01	NO	1.70E-01	NO	
INORGANICS (mg/kg)																	
Antimony		NO		NO		NO		NO		NO		NO		NO		NO	
Arsenic		NO	1.24E+01	YES		NO		NO		NO		NO		NO		NO	YES
Barium		NO		NO		NO		NO		NO		NO		NO		NO	
Cadmium	6.80E-01	NO		NO		NO		NO		NO		NO		NO	1.10E+00	YES	YES
Chromium VI		NO		NO	3.00E+01	YES	7.34E+01	YES		NO		NO		NO		NO	YES
Lead		NO		NO		NO		NO		NO		NO		NO		NO	
Manganese		NO		NO		NO		NO		NO		NO		NO		NO	
Mercury		NO		NO		NO		NO		NO		NO		NO		NO	
Zinc		NO		NO		NO		NO		NO		NO		NO		NO	
ORGANICS (mg/kg)																	
Aroclor 1260 (PCB)	1.30E-01	NO		NO		NO		NO		NO	2.10E-02	NO		NO		NO	
Benzo(a)pyrene		NO	1.10E-01	NO		NO		NO		NO		NO		NO		NO	
Chrysene		NO	1.40E-01	NO		NO		NO		NO		NO		NO		NO	
Pentachlorophenol	5.30E-02	NO		NO		NO		NO		NO		NO	5.60E-01	NO		NO	

* Maximum concentrations are screened against the PRG (preliminary remediation goal). "Yes" if the value exceeds the PRG. "No" if the value is below the PRG.
The COPC (contaminants of potential concern) are refined based on the soil concentration and the PRG.
A blank under "Max" means either no information is available or the constituent was not detected.

(a) PRGs are established to be protective of groundwater, human and ecological receptors.
(b) PRGs are established to be protective of groundwater.
Source:
DOE-RL, 1993d, Tables 3-40

DRAFT

Table G2-6. 116-D-1A Refined Contaminants of Potential Concern Based on Occasional Land Use Scenario and Protection of Groundwater.

116-D-1A	Zone 1 (a)						Zone 2 (b)																Refined COPC
	0 - 3 ft		3 - 6 ft		6 - 10 ft		10 - 15 ft		15 - 20 ft		20 - 25 ft		25 - 30 ft		30 - 35 ft		35 - 40 ft		40 - 45 ft		45 - 50 ft		
	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Summary
RADIONUCLIDES (pCi/g)																							
Am-241	1.70E-01	NO		NO	1.20E-01	NO	1.50E-02	NO	1.00E+00	NO	1.10E+00	NO	1.10E+00	NO	1.40E+00	NO		NO	1.30E+00	NO	1.30E+00	NO	
C-14	4.00E-01	NO		NO	4.00E-01	NO		NO	4.50E-01	NO		NO	4.80E-01	NO	1.50E-01	NO		NO	3.60E-01	NO	2.90E-02	NO	
Cs-134	2.25E-04	NO		NO		NO	7.00E-02	NO		NO	1.79E-02	NO	6.40E-03	NO		NO		NO		NO		NO	
Cs-137	2.57E+01	YES	2.18E+01	YES	7.88E-02	NO	4.37E+01	NO	1.48E+02	NO	3.74E+02	NO	3.05E+02	NO	1.90E+02	NO		NO	9.46E+01	NO	9.46E+01	NO	YES
Co-60	1.02E+00	NO	7.93E-01	NO		NO	1.15E+01	NO	1.09E+01	NO	8.91E+00	NO	5.25E+00	NO	1.54E+00	NO		NO	5.57E+00	NO	5.57E+00	NO	
Eu-152	9.17E+00	YES	6.63E+00	YES		NO	1.24E+02	NO	1.12E+02	NO	5.75E+01	NO	7.07E+01	NO	3.81E+01	NO		NO	5.90E+01	NO	5.90E+01	NO	YES
Eu-154	1.69E-01	NO	8.24E-01	NO		NO	1.79E+01	NO	1.00E+01	NO	5.97E+00	NO	6.25E+01	NO	6.17E+00	NO		NO	7.25E+00	NO	7.25E+00	NO	
Eu-155	8.24E-02	NO	2.03E-02	NO		NO	2.09E-01	NO		NO	3.32E+00	NO	2.35E+00	NO		NO		NO		NO		NO	
H-3		NO		NO		NO	3.40E+01	NO		NO	4.46E+01	NO		NO		NO		NO		NO		NO	
K-40	1.04E+01	NO		NO	1.31E+01	NO	1.34E+01	NO	6.40E+00	NO	7.73E+00	NO	8.70E+00	NO	8.27E+00	NO		NO	1.20E+01	NO	1.20E+01	NO	
Na-22	3.38E+00	NO		NO		NO		NO	4.72E+00	NO	2.39E+00	NO	2.39E+00	NO	1.84E+00	NO		NO	2.60E+00	NO	2.60E+00	NO	
Ni-63		NO		NO		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Pu-238		NO		NO		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Pu-239/240	4.60E-01	NO	2.70E-01	NO	4.70E-01	NO	1.50E+00	YES	6.80E+00	YES	7.10E+00	YES	7.10E+00	YES	8.30E+00	YES		NO	5.70E+00	YES	5.70E+00	YES	YES
Ra-226		NO		NO	8.03E-01	NO	1.00E+00	YES		NO	4.28E+01	YES	4.28E+01	YES		NO		NO		NO		NO	YES
Sr-90	5.00E+00	NO	2.99E+00	NO	4.20E+00	NO	3.67E+01	NO	1.10E-01	NO	3.94E+00	NO	6.65E+00	NO	1.20E+00	NO		NO	2.20E+00	NO	1.80E+00	NO	
Tc-99		NO		NO		NO	8.00E-02	NO	9.90E-02	NO		NO	2.70E-01	NO	5.10E-01	NO		NO		NO		NO	
Th-228	5.72E-01	NO		NO	6.36E-01	NO	6.70E-01	NO		NO		NO	5.00E-01	NO		NO		NO		NO		NO	
Th-232		NO		NO		NO		NO		NO		NO		NO		NO		NO		NO		NO	
U-233/234		NO		NO		NO		NO		NO		NO		NO		NO		NO		NO		NO	
U-235	7.10E-03	NO		NO	4.40E-03	NO	5.40E-03	NO	6.70E-03	NO	1.20E-02	NO	1.20E-02	NO	7.30E-03	NO		NO	9.10E-03	NO	8.60E-03	NO	
U-238 (k)	1.10E-01	NO		NO	1.30E-01	NO	1.80E-01	NO	2.80E-01	NO	2.70E-01	NO	4.00E-02	NO	1.10E-01	NO		NO	1.20E-01	NO	1.20E-01	NO	
INORGANICS (mg/kg)																							
Antimony		NO		NO		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Arsenic		NO		NO		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Barium		NO		NO		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Cadmium		NO		NO		NO		NO	1.00E+00	YES		NO		NO	9.50E-01	YES		NO	1.00E+00	YES		NO	YES
Chromium VI		NO		NO		NO	4.16E+01	YES	6.71E+01	YES		NO		NO	1.88E+02	YES		NO	4.21E+01	YES		NO	YES
Lead		NO		NO		NO		NO	3.86E+01	YES	1.97E+01	YES	2.76E+01	YES	5.19E+01	YES		NO	1.60E+01	YES	1.60E+01	YES	YES
Manganese		NO		NO		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Mercury		NO		NO		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Zinc		NO		NO		NO		NO		NO		NO		NO		NO		NO		NO		NO	
ORGANICS (mg/kg)																							
Aroclor 1260 (PCB)		NO		NO		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Benzo(a)pyrene		NO		NO		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Chrysene		NO		NO		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Pentachlorophenol		NO		NO		NO		NO		NO		NO		NO		NO		NO		NO		NO	

* [illegible] are screened against the PRG (preliminary remediation goal). "Yes" if the value exceeds the PRG. "No" if the value is below the PRG.
The COPC (contaminants of potential concern) are refined based on the soil concentration and the PRG.
A blank under "Max" means either no information is available or the constituent was not detected.

(a) PRGs [illegible]
(b) PRGs are established to be protective of groundwater.
Sources:
[illegible] Table [illegible]
DOE-RL [illegible] Tables [illegible]

Table G2-7. 116-D-1B Refined Contaminants of Potential Concern Based on Occasional Land Use Scenario and Protection of Groundwater.

116-D-1B	Zone 1 (a)						Zone 2 (b)														Refined COPC
	0 - 1 ft		3 - 6 ft		6 - 10 ft		10 - 15 ft		15 - 20 ft		20 - 25 ft		25 - 30 ft		30 - 35 ft		35 - 40 ft				
	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Summary		
RADIONUCLIDES (pCi/g)																					
Am-241		NO		NO		NO	1.30E+00	NO	1.30E+00	NO	7.10E-02	NO	7.10E-02	NO		NO		NO			
C-14		NO		NO		NO	2.30E-02	NO	4.40E-01	NO	3.50E-01	NO	5.00E-01	NO	6.00E-01	NO		NO			
Cs-134		NO		NO		NO	1.75E-02	NO		NO		NO	1.95E-01	NO	1.95E-01	NO		NO			
Cs-137	9.69E+00	YES	2.49E+01	YES		NO	3.22E+02	NO	3.22E+02	NO	3.88E+01	NO	4.22E+01	NO	5.35E-02	NO		NO	YES		
Co-60	2.44E-01	NO	1.12E+00	NO		NO	1.61E+01	NO	1.63E+01	NO	2.32E+00	NO	1.71E+00	NO	3.00E-02	NO		NO			
Eu-152	2.21E+00	NO	9.72E+00	YES		NO	1.47E+02	NO	1.47E+02	NO	6.63E+00	NO	1.19E+01	NO	1.42E+00	NO		NO	YES		
Eu-154	3.41E-01	NO	1.11E+00	NO		NO	1.59E+01	NO	9.82E+01	NO	4.23E-01	NO	1.48E+00	NO	1.00E-01	NO		NO			
Eu-155	1.18E-02	NO	5.67E-02	NO		NO	7.38E+01	NO	3.85E-02	NO	2.68E-02	NO	1.00E-01	NO	1.00E-01	NO		NO			
H-3		NO		NO		NO	7.29E+00	NO	6.08E+00	NO		NO		NO	8.51E+00	NO		NO			
K-40		NO		NO		NO	8.99E+00	NO	1.41E+01	NO	8.86E+00	NO	8.86E+00	NO	8.84E+00	NO		NO			
Na-22		NO		NO		NO	5.70E+00	NO	5.70E+00	NO		NO	1.25E-01	NO	1.25E-01	NO		NO			
Ni-63		NO		NO		NO		NO		NO		NO		NO		NO		NO			
Pu-238		NO		NO		NO		NO		NO		NO		NO		NO		NO			
Pu-239/240		NO	3.00E-01	NO		NO	5.30E+00	YES	5.30E+00	YES	4.60E-01	NO	3.20E-01	NO		NO		NO	YES		
Ra-226		NO		NO		NO		NO		NO		NO	5.00E-01	NO	6.00E-01	NO		NO			
Sr-90	1.63E+00	NO	5.36E+00	NO	3.20E+01	NO	3.20E+01	NO	4.07E+01	NO	8.40E+00	NO	8.40E+00	NO	1.97E+01	NO		NO			
Tc-99		NO		NO		NO		NO	4.90E-03	NO		NO	1.20E-01	NO	1.20E-01	NO		NO			
Th-228		NO		NO		NO		NO		NO	8.25E-01	NO	8.25E-01	NO	5.35E-01	NO		NO			
Th-232		NO		NO		NO		NO		NO		NO	6.08E-01	NO	6.08E-01	NO		NO			
U-233/234		NO		NO		NO		NO		NO		NO		NO		NO		NO			
U-235		NO		NO		NO	6.70E-03	NO	6.70E-03	NO		NO		NO		NO		NO			
U-238		NO		NO		NO	2.50E-01	NO	2.50E-01	NO	1.20E-01	NO	1.20E-01	NO		NO		NO			
INORGANICS (mg/kg)																					
Antimony		NO		NO		NO		NO		NO		NO		NO		NO		NO			
Arsenic		NO		NO		NO		NO		NO		NO		NO		NO		NO			
Barium		NO		NO		NO		NO		NO		NO		NO		NO		NO			
Cadmium		NO		NO		NO		NO		NO		NO		NO		NO		NO			
Chromium VI		NO		NO		NO	3.04E+01	YES	3.04E+01	YES		NO		NO		NO		NO	YES		
Lead		NO		NO		NO	2.20E+01	YES	2.20E+01	YES		NO		NO		NO		NO	YES		
Manganese		NO		NO		NO		NO		NO		NO		NO		NO		NO			
Mercury		NO		NO		NO		NO		NO		NO		NO		NO		NO			
Zinc		NO		NO		NO	1.06E+02	NO	1.06E+02	NO		NO		NO		NO		NO			
ORGANICS (mg/kg)																					
Aroclor 1260 (PCB)		NO		NO		NO		NO		NO		NO		NO		NO		NO			
Benzo(a)pyrene		NO		NO		NO		NO		NO		NO		NO		NO		NO			
Chrysene		NO		NO		NO		NO		NO		NO	5.80E-02	NO	5.80E-02	NO		NO			
Pentachlorophenol		NO		NO		NO		NO		NO		NO		NO		NO		NO			

* Maximum concentrations are screened against the PRG (preliminary remediation goal). "Yes" if the value exceeds the PRG. "No" if the value is below the PRG.
The COPCs (contaminants of potential concern) are refined based on the soil concentration and the PRG.
A blank under "Max" means either no information is available or the constituent was not detected.

(a) PRGs are established to be protective of groundwater, human and ecological receptors.
(b) PRGs are established to be protective of groundwater.

Sources:
Dorian, J.J. and V.R. Richards, 1978, Tables 3-4-13
DOE-RL, 1993d, Tables 3-6, 8, 9
Italicized values are reported as "less than" in the source documents.

Table G2-8. 116-DR-1 Refined Contaminants of Potential Concern Based on Occasional Land Use Scenario.

	Zone 1 (a)						Zone 2 (b)												Refined
116-DR-1	0 - 3 ft		3 - 6 ft		6 - 10 ft		10 - 15 ft		15 - 20 ft		20 - 25 ft		25 - 30 ft		30 - 35 ft		35 - 40 ft		COPC
	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Summary
RADIONUCLIDES (pCi/g)																			
Am-241		NO		NO		NO	1.50E-01	NO	1.50E-01	NO	3.40E-02	NO	9.40E-03	NO	1.30E-02	NO		NO	
C-14		NO		NO		NO	8.40E-02	NO	8.40E-02	NO	1.70E-01	NO	5.30E-01	NO	1.00E-02	NO		NO	
Cs-134		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Cs-137		NO		NO		NO	1.47E+02	NO	1.47E+02	NO	2.88E+01	NO		NO	1.98E-01	NO		NO	
Co-60		NO		NO		NO	2.31E+01	NO	2.31E+01	NO	1.59E+00	NO		NO		NO		NO	
Eu-152		NO		NO		NO	2.58E+02	NO	2.58E+02	NO	1.33E+01	NO	3.36E-01	NO	3.39E-01	NO		NO	
Eu-154		NO		NO		NO	2.57E+01	NO	2.57E+01	NO	1.59E+00	NO		NO		NO		NO	
Eu-155		NO		NO		NO		NO		NO		NO		NO		NO		NO	
H-3		NO		NO		NO		NO		NO		NO		NO		NO		NO	
K-40		NO		NO		NO	2.00E+01	NO	2.00E+01	NO	8.42E+00	NO	1.03E+01	NO	1.02E+01	NO		NO	
Na-22		NO		NO		NO	9.91E+00	NO	9.91E+00	NO	6.10E-01	NO		NO		NO		NO	
Ni-63		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Pu-238		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Pu-239/240		NO		NO		NO	8.20E-01	NO	8.20E-01	NO	1.20E-01	NO	1.90E-02	NO	1.10E-01	NO		NO	
Ra-226		NO		NO		NO		NO		NO	6.60E-01	NO	9.24E-01	NO		NO		NO	
Sr-90		NO		NO		NO	1.00E+01	NO	1.00E+01	NO	2.20E+00	NO	1.70E+00	NO	1.60E-01	NO		NO	
Tc-99		NO		NO		NO	9.10E-01	NO	9.10E-01	NO	5.30E-01	NO		NO		NO		NO	
Th-228		NO		NO		NO		NO	5.08E-01	NO	5.08E-01	NO	4.64E-01	NO	4.33E-01	NO		NO	
Th-232		NO		NO		NO		NO		NO		NO		NO		NO		NO	
U-233/234		NO		NO		NO		NO		NO		NO		NO		NO		NO	
U-235		NO		NO		NO	1.30E-02	NO	1.30E-02	NO	1.30E-02	NO	5.10E-03	NO		NO		NO	
U-238 (k)		NO		NO		NO	2.00E-01	NO	2.00E-01	NO	1.90E-01	NO	1.30E-01	NO	1.20E-01	NO		NO	
INORGANICS (mg/kg)																			
Antimony		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Arsenic		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Barium		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Cadmium		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Chromium VI		NO		NO		NO	1.86E+02	YES	1.86E+02	YES		NO		NO		NO		NO	YES
Lead		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Manganese		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Mercury		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Zinc		NO		NO		NO	1.09E+02	NO	1.09E+02	NO		NO		NO		NO		NO	
ORGANICS (mg/kg)																			
Aroclor 1260 (PCB)		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Benzo(a)pyrene		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Chrysene		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Pentachlorophenol		NO		NO		NO		NO		NO		NO		NO		NO		NO	

* Maximum concentrations are screened against the PRG (preliminary remediation goal). "Yes" if the value exceeds the PRG. "No" if the value is below the PRG.
The COPC (contaminants of potential concern) are refined based on the soil concentration and the PRG.
A blank under "Max" means either no information is available or the constituent was not detected.

(a) PRGs are established to be protective of groundwater, human and ecological receptors
(b) PRGs are established to be protective of groundwater
Source
DOE-RL, 1993b, Tables 3-2,3
Site specific data for 116-DR-1. See 116-DR-2 for historical data

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Table G2-9. 116-DR-2 Refined Contaminants of Potential Concern Based on Occasional Land Use Scenario.

116-DR-2	Zone 1 (a)						Zone 2 (b)												Refined
	0 - 3 ft		3 - 6 ft		6 - 10 ft		10 - 15 ft		15 - 20 ft		20 - 25 ft		25 - 30 ft		30 - 35 ft		35 - 40 ft		COPC
	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Summary
RADIONUCLIDES (pCi/g)																			
Am-241		NO		NO		NO	2.60E-02	NO	2.60E-02	NO	5.50E-03	NO		NO		NO		NO	
C-14		NO		NO		NO	8.30E-01	NO	8.30E-01	NO	6.80E-01	NO	1.20E-01	NO	1.90E-01	NO	6.60E-03	NO	
Cs-134		NO		NO	2.07E-03	NO	1.20E-02	NO	1.43E-03	NO	1.10E-02	NO	7.20E-02	NO		NO		NO	
Cs-137		NO		NO	5.61E+01	YES	2.23E+02	NO	2.33E+02	NO	8.30E+02	YES	3.53E+01	NO		NO		NO	YES
Co-60		NO		NO	1.95E+00	NO	1.34E+01	NO	5.73E+00	NO	3.90E+01	NO	2.44E+00	NO		NO		NO	
Eu-152		NO		NO	4.42E+01	YES	2.03E+02	NO	2.40E+01	NO	2.78E+02	NO	9.72E+00	NO		NO		NO	YES
Eu-154		NO		NO	5.96E+00	NO	2.81E+01	NO	2.53E+00	NO	4.26E+01	NO	2.84E+00	NO		NO		NO	
Eu-155		NO		NO	5.56E-01	NO	3.10E+00	NO	2.14E-02	NO	9.84E-01	NO	2.25E-01	NO		NO		NO	
H-3		NO		NO	1.01E+00	NO	6.08E+00	NO		NO	5.67E+00	NO		NO		NO		NO	
K-40		NO		NO		NO	1.00E+01	NO	1.00E+01	NO	9.09E+00	NO	8.73E+00	NO		NO		NO	
Na-22		NO		NO		NO	9.79E-01	NO	9.79E-01	NO		NO		NO		NO		NO	
Ni-63		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Pu-238		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Pu-239/240		NO		NO	5.10E-01	NO	1.40E+01	YES	1.40E+01	YES	3.20E+00	NO		NO		NO		NO	YES
Ra-226		NO		NO		NO		NO		NO		NO	4.07E-01	NO		NO		NO	
Sr-90		NO		NO	3.19E+00	NO	5.09E+00	NO	7.80E-01	NO	9.51E+00	NO	4.55E+00	NO	9.90E-01	NO	1.70E+00	NO	
Tc-99		NO		NO		NO		NO		NO		NO	3.40E-01	NO	1.10E+00	NO		NO	
Th-228		NO		NO		NO		NO		NO		NO	3.67E-01	NO		NO		NO	
Th-232		NO		NO		NO		NO		NO		NO	4.83E-01	NO		NO		NO	
U-233/234		NO		NO		NO		NO		NO		NO		NO		NO		NO	
U-235		NO		NO		NO		NO		NO		NO		NO		NO		NO	
U-238 (k)		NO		NO	1.80E-01	NO	1.80E-01	NO	1.70E-01	NO	3.80E-01	NO		NO		NO		NO	
INORGANICS (mg/kg)																			
Antimony		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Arsenic		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Barium		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Cadmium		NO		NO		NO		NO	1.10E+00	YES		NO		NO		NO		NO	YES
Chromium VI		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Lead		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Manganese		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Mercury		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Zinc		NO		NO		NO		NO		NO		NO		NO		NO		NO	
ORGANICS (mg/kg)																			
Aroclor 1260 (PCB)		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Benzo(a)pyrene		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Chrysene		NO		NO		NO		NO		NO		NO		NO		NO		NO	
Pentachlorophenol		NO		NO		NO		NO		NO		NO		NO		NO		NO	

* Maximum concentrations are screened against the PRG (preliminary remediation goal). "Yes" if the value exceeds the PRG. "No" if the value is below the PRG.
The COPC (contaminants of potential concern) are refined based on the soil concentration and the PRG.
A blank under "Max" means either no information is available or the constituent was not detected.

(a) PRGs are established to be protective of groundwater, human and ecological receptors
(b) PRGs are established to be protective of groundwater
Sources
Dorian, J.J., and V.R. Richards, 1978, Tables 2.7-47
Historical data is for 116-DR-1 and 116-DR-2 combined
DOE-RL, 1993d, Tables 3-36, 3-37

Table G2-10. 116-D-2A Refined Contaminants of Potential Concern Based on Occasional Use Scenario.

116-D-2A	Zone 1 (a)						Zone 2 (b)										Refined COPC
	0 - 3 ft		3 - 6 ft		6 - 10 ft		10 - 15 ft		15 - 20 ft		20 - 25 ft		25 - 30 ft		30 - 35 ft		
	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Summary
RADIONUCLIDES (pCi/g)																	
Am-241		NO		NO		NO	1.00E-01	NO	1.50E-02	NO	6.00E-04	NO		NO		NO	
C-14		NO		NO		NO	4.40E-02	NO		NO		NO		NO		NO	
Cs-134		NO		NO		NO		NO		NO		NO		NO		NO	
Cs-137		NO		NO		NO	1.05E+02	NO	1.99E+01	NO	1.07E+00	NO		NO		NO	
Co-60		NO		NO		NO	1.62E-01	NO		NO		NO		NO		NO	
Eu-152		NO		NO		NO	6.87E+00	NO	1.26E+00	NO		NO		NO		NO	
Eu-154		NO		NO		NO	5.01E+00	NO		NO		NO		NO		NO	
Eu-155		NO		NO		NO		NO		NO		NO		NO		NO	
H-3		NO		NO		NO		NO		NO		NO		NO		NO	
K-40		NO		NO		NO	1.07E+01	NO	1.34E+01	NO	8.54E+00	NO		NO		NO	
Na-22		NO		NO		NO	2.14E-01	NO		NO		NO		NO		NO	
Ni-63		NO		NO		NO		NO		NO		NO		NO		NO	
Pu-238		NO		NO		NO		NO		NO		NO		NO		NO	
Pu-239/240		NO		NO		NO	1.00E+00	NO	1.40E-01	NO	1.40E-02	NO		NO		NO	
Ra-226		NO		NO		NO	**1.30E+01**	**YES**		NO		NO		NO		NO	YES
Sr-90		NO		NO		NO	2.60E+01	NO	3.60E+00	NO	3.30E-01	NO		NO		NO	
Tc-99		NO		NO		NO	5.80E-02	NO	8.00E-02	NO		NO		NO		NO	
Th-228		NO		NO		NO	3.77E-01	NO	6.30E-01	NO	4.23E-01	NO		NO		NO	
Th-232		NO		NO		NO		NO		NO		NO		NO		NO	
U-233/234		NO		NO		NO		NO		NO		NO		NO		NO	
U-235		NO		NO		NO	8.40E-03	NO	5.40E-03	NO	1.70E-02	NO		NO		NO	
U-238 (k)		NO		NO		NO	1.30E-01	NO	1.80E-01	NO	9.20E-02	NO		NO		NO	
INORGANICS (mg/kg)																	
Antimony		NO		NO		NO		NO		NO		NO		NO		NO	
Arsenic		NO		NO		NO		NO		NO		NO		NO		NO	
Barium		NO		NO		NO		NO		NO		NO		NO		NO	
Cadmium		NO		NO		NO		NO		NO		NO		NO		NO	
Chromium VI		NO		NO		NO		NO		NO		NO		NO		NO	
Lead		NO		NO		NO		NO		NO		NO		NO		NO	
Manganese		NO		NO		NO		NO		NO		NO		NO		NO	
Mercury		NO		NO		NO		NO		NO		NO		NO		NO	
Zinc		NO		NO		NO		NO		NO		NO		NO		NO	
ORGANICS (mg/kg)																	
Aroclor 1260 (PCB)		NO		NO		NO		NO		NO		NO		NO		NO	
Benzo(a)pyrene		NO		NO		NO		NO		NO		NO		NO		NO	
Chrysene		NO		NO		NO		NO		NO		NO		NO		NO	
Pentachlorophenol		NO		NO		NO		NO		NO		NO		NO		NO	

* Maximum concentrations are screened against the PRG (preliminary remediation goal). "Yes" if the value exceeds the PRG. "No" if the value is below the PRG.
The COPC (contaminants of potential concern) are refined based on the soil concentration and the PRG.
A blank under "Max" means either no information is available or the constituent was not detected.

(a) PRGs are established to be protective of groundwater, human and ecological receptors.
(b) PRGs are established to be protective of groundwater.
Source:
DOE-RL, 1993d, Tables 3-40

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Table G2-11. 116-D-9 Refined Contaminants of Potential Concern Based on Occasional Use Scenario.

116-D-9	Zone 1 (a)								Zone 2 (b)								Refined
	0 - 3 ft		3 - 6 ft		6 - 10 ft		10 - 15 ft		15 - 20 ft		20 - 25 ft		25 - 30 ft		30 - 35 ft		COPC
	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Max	Screening*	Summary
RADIONUCLIDES (pCi/g)																	
Am-241		NO		NO		NO		NO	6.10E-03	NO	6.10E-03	NO		NO		NO	
C-14		NO		NO		NO		NO	2.60E-01	NO	2.60E-01	NO	1.50E-01	NO		NO	
Cs-134		NO		NO		NO		NO		NO		NO		NO		NO	
Cs-137		NO		NO		NO		NO		NO		NO		NO		NO	
Co-60		NO		NO		NO		NO		NO		NO		NO		NO	
Eu-152		NO		NO		NO		NO		NO		NO		NO		NO	
Eu-154		NO		NO		NO		NO		NO		NO		NO		NO	
Eu-155		NO		NO		NO		NO		NO		NO		NO		NO	
H-3		NO		NO		NO		NO		NO		NO		NO		NO	
K-40		NO		NO		NO		NO	7.39E+00	NO	7.39E+00	NO	9.35E+00	NO		NO	
Na-22		NO		NO		NO		NO		NO		NO		NO		NO	
Ni-63		NO		NO		NO		NO		NO		NO		NO		NO	
Pu-238		NO		NO		NO		NO		NO		NO		NO		NO	
Pu-239/240		NO		NO		NO		NO		NO		NO		NO		NO	
Ra-226		NO		NO		NO		NO	3.55E-01	NO	3.55E-01	NO	7.26E-01	NO		NO	
Sr-90		NO		NO		NO		NO	2.90E+00	NO	2.90E+00	NO	8.80E-02	NO		NO	
Tc-99		NO		NO		NO		NO		NO		NO		NO		NO	
Th-228		NO		NO		NO		NO	3.52E-01	NO	3.52E-01	NO	4.79E-01	NO		NO	
Th-232		NO		NO		NO		NO		NO		NO		NO		NO	
U-233/234		NO		NO		NO		NO		NO		NO		NO		NO	
U-235		NO		NO		NO		NO		NO		NO		NO		NO	
U-238 (k)		NO		NO		NO		NO	1.80E-01	NO	1.80E-01	NO	3.20E-01	NO		NO	
INORGANICS (mg/kg)																	
Antimony		NO		NO		NO		NO		NO		NO		NO		NO	
Arsenic		NO		NO		NO		NO		NO		NO		NO		NO	
Barium		NO		NO		NO		NO		NO		NO		NO		NO	
Cadmium		NO		NO		NO		NO		NO		NO		NO		NO	
Chromium VI		NO		NO		NO		NO		NO		NO		NO		NO	
Lead		NO		NO		NO		NO		NO		NO		NO		NO	
Manganese		NO		NO		NO		NO		NO		NO		NO		NO	
Mercury		NO		NO		NO		NO		NO		NO		NO		NO	
Zinc		NO		NO		NO		NO		NO		NO		NO		NO	
ORGANICS (mg/kg)																	
Aroclor 1260 (PCB)		NO		NO		NO		NO		NO		NO		NO		NO	
Benzo(a)pyrene		NO		NO		NO		NO		NO		NO		NO		NO	
Chrysene		NO		NO		NO		NO		NO		NO		NO		NO	
Pentachlorophenol		NO		NO		NO		NO		NO		NO		NO		NO	

* Maximum concentrations are screened against the PRG (preliminary remediation goal). "Yes" if the value exceeds the PRG. "No" if the value is below the PRG.
The COPC (contaminants of potential concern) are refined based on the soil concentration and the PRG.
A blank under "Max" means either no information is available or the constituent was not detected.

(a) PRGs are established to be protective of groundwater, human and ecological receptors.
(b) PRGs are established to be protective of groundwater.
Source:
DOE-RL, 1993d, Tables 3-42

Table G2-12. 100-DR-1 Waste-site Profiles.
(Page 1 of 12)

Waste Site (group)	Extent of Contamination					Media/ Material	Refined COPC	Maximum Concentration Detected (a)	Are Reduced Infiltration Concentrations Exceeded?
	Volume (m^3)	Length (m)	Width (m)	Area (m^2)	Depth (m)				
116-D-7 (retention basins)	125760.0	148.4	79.2	11753.0	10.7	Soil Concrete Sludge	Radionuclides	pCi/g	
							^{14}C	4.3×10^2	NO
							^{60}Co	3.05×10^3	NO
							^{137}Cs	1.32×10^3	NO
							^{152}Eu	2.96×10^4	NO
							^{154}Eu	9.94×10^3	NO
							^{3}H	1.98×10^4	NO
							$^{239/240}Pu$	2.90×10^2	NO
							^{90}Sr	3.73×10^2	NO
							Inorganics	mg/kg	
							Chromium VI	5.16×10^1	YES
107 D/DR #1 (sludge trench)	2316.0	38.1	15.2	652.0	4.0	Sludge	Radionuclides	assumed from 116-DR-9 and 116-D-7 data	
							^{14}C		NO
							^{137}Cs		NO
							^{60}Co		NO
							^{152}Eu		NO
							^{154}Eu		NO
							^{3}H		NO
							$^{239/240}Pu$		NO
							^{90}Sr		NO
							^{226}Ra		NO
							^{228}Th		NO
							Inorganics		
							Arsenic		YES
							Cadmium		NO
							Chromium VI		YES

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Table G2-12. 100-DR-1 Waste-site Profiles. (Page 2 of 12)

Waste Site (group)	Extent of Contamination					Media/ Material	Refined COPC	Maximum Concentration Detected (a)	Are Reduced Infiltration Concentrations Exceeded?
	Volume (m^3)	Length (m)	Width (m)	Area (m^2)	Depth (m)				
107 D/DR #2 (sludge trench)	2316.0	38.1	15.2	572.0	4.0	Sludge	Radionuclides	assumed from 116-DR-9 and 116-D-7 data	
							^{14}C		NO
							^{137}Cs		NO
							^{60}Co		NO
							^{152}Eu		NO
							^{154}Eu		NO
							^{3}H		NO
							$^{239/240}Pu$		NO
							^{90}Sr		NO
							^{226}Ra		NO
							^{228}Th		NO
							Inorganics		
							Arsenic		YES
							Cadmium		NO
							Chromium VI		YES

Table G2-12. 100-DR-1 Waste-site Profiles.
(Page 3 of 12)

Waste Site (group)	Extent of Contamination					Media/ Material	Refined COPC	Maximum Concentration Detected (a)	Are Reduced Infiltration Concentrations Exceeded?
	Volume (m^3)	Length (m)	Width (m)	Area (m^2)	Depth (m)				
107 D/DR #3 (sludge trench)	2316.0	38.1	15.2	579.0	4.0	Sludge	Radionuclides	assumed from 116-DR-9 and 116-D-7 data	
							^{14}C		NO
							^{137}Cs		NO
							^{60}Co		NO
							^{152}Eu		NO
							^{154}Eu		NO
							^{3}H		NO
							$^{239/240}Pu$		NO
							^{90}Sr		NO
							^{226}Ra		NO
							^{228}Th		NO
							Inorganics		
							Arsenic		YES
							Cadmium		NO
							Chromium VI		YES

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Table G2-12. 100-DR-1 Waste-site Profiles. (Page 4 of 12)

Waste Site (group)	Extent of Contamination					Media/ Material	Refined COPC	Maximum Concentration Detected (a)	Are Reduced Infiltration Concentrations Exceeded?
	Volume (m^3)	Length (m)	Width (m)	Area (m^2)	Depth (m)				
107 D/DR #4 (sludge trench)	1561.0	32.0	12.2	390.0	4.0	Sludge	Radionuclides	assumed from 116-DR-9 and 116-D-7 data	
							^{14}C		NO
							^{137}Cs		NO
							^{60}Co		NO
							^{152}Eu		NO
							^{154}Eu		NO
							^{3}H		NO
							$^{239/240}Pu$		NO
							^{90}Sr		NO
							^{226}Ra		NO
							^{228}Th		NO
							Inorganics		
							Arsenic		YES
							Cadmium		NO
							Chromium VI		YES

Table G2-12. 100-DR-1 Waste-site Profiles.
(Page 5 of 12)

Waste Site (group)	Extent of Contamination					Media/ Material	Refined COPC	Maximum Concentration Detected (a)	Are Reduced Infiltration Concentrations Exceeded?
	Volume (m^3)	Length (m)	Width (m)	Area (m^2)	Depth (m)				
107 D/DR #5 (sludge trench)	2005.0	27.4	18.3	501.0	4.0	Sludge	<u>Radionuclides</u>	assumed from 116-DR-9 and 116-D-7 data	
							^{14}C		NO
							^{137}Cs		NO
							^{60}Co		NO
							^{152}Eu		NO
							^{154}Eu		NO
							^{3}H		NO
							$^{239/240}Pu$		NO
							^{90}Sr		NO
							^{226}Ra		NO
							^{228}Th		NO
							<u>Inorganics</u>		
							Arsenic		YES
							Cadmium		NO
							Chromium VI		YES

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Table G2-12. 100-DR-1 Waste-site Profiles. (Page 6 of 12)

Waste Site (group)	Extent of Contamination: Volume (m^3)	Length (m)	Width (m)	Area (m^2)	Depth (m)	Media/ Material	Refined COPC	Maximum Concentration Detected (a)	Are Reduced Infiltration Concentrations Exceeded?
116-DR-9 (retention basin)	260414.0	210.3	101.5	21345.0	12.2	Soil Concrete Sludge	Radionuclides	pCi/g	
							^{14}C	$1.8x10^{2}$	NO
							^{60}Co	$2.07x10^{3}$	NO
							^{137}Cs	$3.25x10^{3}$	NO
							^{152}Eu	$1.11x10^{4}$	NO
							^{154}Eu	$3.98x10^{3}$	NO
							$^{239/240}Pu$	$6.50x10^{1}$	NO
							^{226}Ra	1.25	NO
							^{90}Sr	$1.70x10^{2}$	NO
							^{228}Th	1.02	NO
							Inorganics	mg/kg	
							Arsenic	$1.24x10^{1}$	YES
							Cadmium	1.20	NO
							Chromium VI	$7.34x10^{1}$	YES
116-D-1A (fuel storage basin trench)	4409.0	43.3	6.7	290.0	15.2	Soil	Radionuclides	pCi/g	
							^{137}Cs	$2.57x10^{1}$	NO
							^{152}Eu	9.17	NO
							$^{239/240}Pu$	8.30	NO
							^{226}Ra	$4.28x10^{1}$	YES
							Inorganics	mg/kg	
							Cadmium	1.00	NO
							Chromium VI	$1.08x10^{2}$	YES
							Lead	$5.19x10^{2}$	NO

Table G2-12. 100-DR-1 Waste-site Profiles.
(Page 7 of 12)

Waste Site (group)	Extent of Contamination					Media/ Material	Refined COPC	Maximum Concentration Detected (a)	Are Reduced Infiltration Concentrations Exceeded?
	Volume (m^3)	Length (m)	Width (m)	Area (m^2)	Depth (m)				
116-D-1B (fuel storage basin trench)	2947.0	39.6	12.2	483.0	6.1	Soil	Radionuclides	pCi/g	
							^{137}Cs	2.49×10^1	NO
							^{152}Eu	9.72	NO
							$^{239/240}Pu$	5.30	NO
							Inorganics		
							Chromium VI	3.04×10^1	YES
							Lead	2.20×10^1	NO
116-DR-1/2 (process effluent trench)	24,447.0	varies	varies	4,215	5.8	Soil	Radionuclides	pCi/g	
							^{137}Cs	8.30×10^2	NO
							^{152}Eu	4.42×10^1	NO
							$^{239/240}Pu$	1.40×10^1	NO
							Inorganics	mg/kg	
							Cadmium	1.10	NO
							Chromium VI	1.86×10^2	YES
116-D-2A (pluto crib)	14.4	3.1	3.1	9.6	1.5	Soil Timbers	Radionuclides	pCi/g	
							^{226}Ra	1.3×10^1	YES
116-D-9 (seal pit crib)	0.0	0.0	0.0	0.0	0.0	NA	None	NA	NA

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Table G2-12. 100-DR-1 Waste-site Profiles. (Page 8 of 12)

Waste Site (group)	Extent of Contamination					Media/ Material	Refined COPC	Maximum Concentration Detected (a)	Are Reduced Infiltration Concentrations Exceeded?
	Volume (m^3)	Length (m)	Width (m)	Area (m^2)	Depth (m)				
100 D/DR (pipelines)	(b)	(b)	(b)	(b)	(b)	Steel Concrete	Radionuclides ^{137}Cs ^{152}Eu ^{154}Eu ^{155}Eu ^{63}Ni ^{238}Pu $^{239/240}Pu$ ^{90}Sr	pCi/g assumed from pipeline group data	NO(c)

Table G2-12. 100-DR-1 Waste-site Profiles.
(Page 9 of 12)

Waste Site (group)	Extent of Contamination					Media/ Material	Refined COPC	Maximum Concentration Detected (a)	Are Reduced Infiltration Concentrations Exceeded?
	Volume (m^3)	Length (m)	Width (m)	Area (m^2)	Depth (m)				
118-D-4A (burial ground)	4564.0	57.9	18.3	1059.0	6.1	Misc. Solid Waste	<u>Radionuclides</u> ^{14}C ^{137}Cs ^{60}Co ^{152}Eu ^{154}Eu ^{3}H ^{63}Ni ^{90}Sr <u>Inorganics</u> Cadmium Lead Mercury <u>Organics</u> -no specific constituents identified, but 5% of volume is assumed to be contaminated by organics	(d)	NO(e)

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Table G2-12. 100-DR-1 Waste-site Profiles.
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Waste Site (group)	Extent of Contamination					Media/ Material	Refined COPC	Maximum Concentration Detected (a)	Are Reduced Infiltration Concentrations Exceeded?
	Volume (m^3)	Length (m)	Width (m)	Area (m^2)	Depth (m)				
118-D-4B (burial ground)	350.0	32.0	7.3	215.0	3.7	Misc. Solid Waste	Radionuclides ^{14}C ^{137}Cs ^{60}Co ^{152}Eu ^{154}Eu ^{3}H ^{63}Ni ^{90}Sr Inorganics Cadmium Lead Mercury Organics -no specific constituents identified, but 5% of volume is assumed to be contaminated by organics	(d)	NO(e)

Table G2-12. 100-DR-1 Waste-site Profiles.
(Page 11 of 12)

Waste Site (group)	Extent of Contamination					Media/ Material	Refined COPC	Maximum Concentration Detected (a)	Are Reduced Infiltration Concentrations Exceeded?
	Volume (m^3)	Length (m)	Width (m)	Area (m^2)	Depth (m)				
118-D-18 (burial ground)	625.0	24.4	12.2	237.0	6.1	Misc. Solid Waste	Radionuclides ^{14}C ^{137}Cs ^{60}Co ^{152}Eu ^{154}Eu ^{3}H ^{63}Ni ^{90}Sr Inorganics Cadmium Lead Mercury Organics -no specific constituents identified, but 5% of volume is assumed to be contaminated by organics	(d)	NO(e)
132-D-1 115-D Gas Recirculation Building (D&D)	0.0	0.0	0.0	0.0	0.0	NA	None	NA	NA

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Table G2-12. 100-DR-1 Waste-site Profiles.
(Page 12 of 12)

Waste Site (group)	Extent of Contamination					Media/ Material	Refined COPC	Maximum Concentration Detected (a)	Are Reduced Infiltration Concentrations Exceeded?
	Volume (m^3)	Length (m)	Width (m)	Area (m^2)	Depth (m)				
132-D-2 117-D Filter Building (D&D)	0.0	0.0	0.0	0.0	0.0	NA	None	NA	NA
132-D-3 Effluent Pumping Station (D&D)	0.0	0.0	0.0	0.0	0.0	NA	None	NA	NA

(a) Where concentration exceeds preliminary remediation goals.
(b) Based on retention basin group profile
(c) Based on group profile
(d) No quantitative data is available. Constituents are assumed from Miller and Wahlen 1987.
(e) It is assumed that burial grounds contain immobile forms of waste; thus, no contaminants are assumed to exceed the reduced infiltration concentrations.
(f) no soil contamination has been identified associated with the pipelines, therefore no volume calculation is made; extent of contamination is limited to the pipeline itself.
COPC contaminants of potential concern
D&D decontamination and decommissioning
NA not applicable

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Table G2-13. Allowable Soil Concentration - Reduced Infiltration Scenario.

Analyte	Soil Concentration
RADIONUCLIDES	**pCi/g**
^{241}Am	$5.01(10^{3})$
^{14}C	$2.92(10^{3})$
^{134}Cs	$8.35(10^{4})$
^{137}Cs	$1.25(10^{5})$
^{60}Co	$2.09(10^{5})$
^{152}Eu	$3.34(10^{6})$
^{154}Eu	$3.34(10^{6})$
^{155}Eu	$1.67(10^{7})$
^{3}H	$8.35(10^{4})$
^{40}K	$2.34(10^{4})$
^{22}Na	$3.34(10^{4})$
^{63}Ni	$7.52(10^{6})$
^{238}Pu	$8.35(10^{2})$
$^{239/240}Pu$	$6.27(10^{2})$
^{226}Ra	$4.00(10^{0})$
^{90}Sr	$2.09(10^{4})$
^{99}Tc	$4.18(10^{3})$
^{228}Th	$1.67(10^{1})$
^{232}Th	$2.09(10^{0})$
$^{233/234}U$	$8.35(10^{2})$
^{235}U	$1.00(10^{3})$
^{238}U	$1.00(10^{3})$
INORGANICS	**mg/kg**
Antimony	$2.51(10^{-1})$
Arsenic	$2.09(10^{0})$
Barium	$4.18(10^{4})$
Cadmium	$1.25(10^{2})$
Chromium (VI)	$4.18(10^{0})$
Lead	$1.25(10^{3})$
Manganese	$2.09(10^{3})$
Mercury	$5.01(10^{1})$
Zinc	$1.25(10^{5})$
ORGANICS	**mg/kg**
Aroclor 1260	$2.21(10^{2})$
Benzo(a)pyrene	$9.19(10^{2})$
Chrysene	$2.00(10^{0})$
Pentachlorophenol	$4.40(10^{1})$

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3.0 RESULTS OF THE PLUG-IN APPROACH

This Section describes how the analysis of Remedial Alternatives for the waste site groups in the Process Document is used in lieu of doing independent analyses for the individual waste sites. The waste sites in the 100 Area source Operable Units were categorized into 10 waste site groups, then several Remedial Alternatives for cleaning up each of the waste site groups were evaluated (see Sections 3.0, 4.0, and 5.0 of the Process Document). To implement the "plug-in" approach, the first step is to identify which waste site group an individual waste site appears to belong to. This is accomplished by comparing the profiles of the individual waste sites presented in Table G2-13 of this FFS to the waste site group descriptions and group profiles given in Section 3.1 and Table 3-1 of the Process Document. The appropriate group for each site is identified in Table G3-1.

The next step in the process is to determine if the individual waste site characteristics meet the applicability criteria for the Remedial Alternatives for that waste site group (see Table 4-2 in the Process Document). If the individual waste site characteristics match the group profile and the applicability criteria completely, there are no deviations from the analysis in the Process Document. In this case the analysis of alternatives in the Process Document is adequate for the individual waste site, and the individual waste site plugs into the existing alternatives analysis in the Process Document. If there are deviations, then further analyses of that waste site are conducted in Sections 4.0, 5.0, and 6.0 of this appendix.

The deviations indicated on Table G3-1 are briefly summarized as follows: 100-D pipelines exclude the Removal/Treatment/Disposal Alternative because there is assumed to be no contaminated soils associated with the contaminated pipe and sludge.

3.1 EXAMPLE OF THE PLUG-IN APPROACH

An example of implementing the plug-in approach for the 116-D-2A waste site is presented here to clarify the process. The process steps are described in Section 1.4 of the Process Document; and the example below illustrates steps 5 and 6 described in that Section. First, the 116-D-2A waste site is identified as a Pluto Crib.

Table G2-2 does not indicate that the 116-D-2A site received solid waste, but shows that the site received effluent waste from the reactor following fuel cladding failures. This indicates that 116-D-2A is a contaminated soil site used for liquid effluent disposal. Table G2-2 does indicate that 116-D-2A is a 3.1 x 3.1 x 3.1 m (10 x 10 x 10 ft) gravel-filled site. It can be concluded that the appropriate group for 116-D-2A is the pluto crib. The profile for the group and the associated detailed and comparative analyses are documented in the Process Document.

The evaluation of the 116-D-2A site against each Remedial Alternative is presented below:

No Action - Data indicate that there is contamination present at the site which warrants action; therefore, no action is not an acceptable alternative.

Institutional Controls - Refined COPC are identified for waste site 116-D-2A in Table G2-10 indicating that there are contaminants present that exceed PRG. Therefore, institutional controls will not effectively address contaminants at the site.

Containment - Because there are contaminants that exceed reduced infiltration concentrations, containment will not be applicable at the site.

Removal/Disposal - Because contaminants exceed PRG this alternative may be applicable.

In Situ Treatment - Because contaminants exceed PRG, and the contaminated lens is <5.8 m (19 ft), the in situ treatment option may be applicable.

Removal/Treatment/Disposal - Because contaminants exceed PRG, this alternative may be applicable. Thermal desorption enhancement is not necessary because organic contaminants are not present at the site. For cost purposes, it is assumed that 100% of the contaminated soil at 116-D-2A can be effectively treated by soil washing. This percentage is based on the depth, distribution, and concentration of contaminants at the waste site. This does not affect the application of the alternative, but does impact the magnitude of volume reduction realized at the site.

The next step is to compare the 116-D-2A waste site characteristics to the applicability criteria for the Remedial Alternatives shown in Table 4-2 of the Process Document. The analysis conducted in the Process Document determined that two Remedial Alternatives were appropriate for Pluto Cribs; Removal/Disposal, and Removal/Treatment/ Disposal. However, the comparison of 116-D-DA characteristics to the applicability criteria indicate a third alternative, in situ vitrification, is also appropriate for this waste site. This deviation between the Process Document (Table 4-2) and the individual waste site assessment are identified and noted in Table G3-1 of this FFS.

The alternatives for waste site 116-D-2A are the same as those for the pluto crib group; therefore, no deviations are identified and the site completely plugs into the analyses for the group.

3.2 RESULTS OF THE PLUG-IN APPROACH

The characteristics of the individual waste sites were compared to the applicability criteria for the Remedial Alternatives (as shown in Table 4-2 of the Process Document), and the results of this evaluation are shown in Table G3-1. The deviation between the individual waste sites and waste site groups are noted in Table G3-1. All of the waste sites directly plug into the waste site group except for the effluent pipelines.

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Table G3-1. Comparison of Waste Sites to Remedial Alternatives. (page 1 of 5)

Waste Site / Group		116-D-7 Retention Basin	116-DR-9 Retention Basin	116-DR-1 116-DR-2 Process Effluent Trench	107-D/DR SLUDGE TRENCHES Sludge Trench
Alternative	**Applicability Criteria and Enhancements**	**Are Applicability Criteria and Enhancements Met?**			
No Action					
SS-1 SW-1	Criterion: • Has site been effectively addressed in the past?	No	No	No	No
Institutional Controls					
SS-2 SW-2	Criterion: • Contaminants < PRG	No	No	No	No
Containment					
SS-3 SW-3	Criteria: • Contaminants > PRG	Yes	Yes	Yes	Yes
	• Contaminants < reduced infiltration rate concentrations	No	No	No	No
Removal/Disposal					
SS-4 SW-4	Criterion: • Contaminants > PRG	Yes	Yes	Yes	Yes
In Situ Treatment					
SS-8A	Criteria: • Contaminants > PRG	Yes	Yes	Yes	Yes
	• Contamination < 5.8 m (19 ft) in depth	No	No	Yes	Yes
SS-8B	Criteria: • Contaminants > PRG	NA	NA	NA	NA
	• Contaminants < reduced infiltration rate concentrations	NA	NA	NA	NA
SW-7	Criteria: • Contaminants > PRG	NA	NA	NA	NA
	• Contaminants < reduced infiltration rate concentrations	NA	NA	NA	NA
Removal/Treatment/Disposal					
SS-10	Criterion: • Contaminants > PRG	Yes	Yes	Yes	Yes
	Enhancements: • Organic contaminants (if yes, thermal desorption must be included in the treatment system)	No	No	No	No
	• Percentage of contaminated volume less than twice the PRG for cesium-137.	67%	67%	100%	67%
SW-9	Criterion: • Contaminants > PRG	NA	NA	NA	NA
	Enhancement: • Organic contaminants	NA	NA	NA	NA

Table G3-1. Comparison of Waste Sites to Remedial Alternatives. (page 2 of 3)

Waste Site Group		116-D-1A Fuel Storage Basin Trench	116-D-1B Fuel Storage Basin Trench	116-D-2A Pluto Crib	116-D-9 Seal Pit Crib
Alternative	**Applicability Criteria and Enhancements**	**Are Applicability Criteria and Enhancements Met?**			
No Action					
SS-1 SW-1	Criterion: • Has site been effectively addressed in the past?	No	No	No	Yes
Institutional Controls					
SS-2 SW-2	Criterion: • Contaminants < PRG	No	No	No	No
Containment					
SS-3 SW-3	Criteria: • Contaminants > PRG	Yes	Yes	Yes	NA
	• Contaminants < reduced infiltration rate concentrations	No	No	No	NA
Removal/Disposal					
SS-4 SW-4	Criterion: • Contaminants > PRG	Yes	Yes	Yes	NA
In Situ Treatment					
SS-8A	Criteria: • Contaminants > PRG	Yes	Yes	Yes	NA
	• Contamination < 5.8 m (19 ft) in depth	No	No	Yes	NA
SS-8B	Criteria: • Contaminants > PRG	NA	NA	NA	NA
	• Contaminants < reduced infiltration rate concentrations	NA	NA	NA	NA
SW-7	Criteria: • Contaminants > PRG	NA	NA	NA	NA
	• Contaminants < reduced infiltration rate concentrations	NA	NA	NA	NA
Removal/Treatment/Disposal					
SS-10	Criterion: • Contaminants > PRG	Yes	Yes	Yes	NA
	Enhancements: • Organic contaminants (if yes, thermal desorption must be included in the treatment system)	No	No	No	NA
	• Percentage of contaminated volume less than twice the PRG for cesium-137.	100%	100%	100%	NA
SW-9	Criterion: • Contaminants > PRG	NA	NA	NA	NA
	Enhancement: • Organic contaminants	NA	NA	NA	NA

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Table G3-1. Comparison of Waste Sites to Remedial Alternatives. (page 3 of 3)

Waste Site / Group		PIPELINES Pipeline	118-D-4A 118-D-4B 118-D-18 Burial Grounds	132-D-1 132-D-2 132-D-3 D&D Facilities
Alternative	**Applicability Criteria and Enhancements**	**Are Applicability Criteria and Enhancements Met?**		
No Action				
SS-1 SW-2	Criterion: • Has site been effectively addressed in the past?	No	No	Yes
Institutional Controls				
SS-2 SW-2	Criterion: • Contaminants < PRG	No	No	NA
Containment				
SS-3 SW-3	Criteria: • Contaminants > PRG	Yes	Yes	NA
	• Contaminants < reduced infiltration rate concentrations	Yes	Yes	NA
Removal/Disposal				
SS-4 SW-4	Criterion: • Contaminants > PRG	Yes	Yes	NA
In Situ Treatment				
SS-8A	Criteria: • Contaminants > PRG	NA	NA	NA
	• Contamination < 5.8 m (19 ft) in depth	NA	NA	NA
SS-8B	Criteria: • Contaminants > PRG	Yes	NA	NA
	• Contaminants < reduced infiltration rate concentrations	Yes	NA	NA
SW-7	Criteria: • Contaminants > PRG	NA	Yes	NA
	• Contaminants < reduced infiltration rate concentrations	NA	Yes	NA
Removal/Treatment/Disposal				
SS-10	Criterion: • Contaminants > PRG	NA(d)	NA	NA
	Enhancements: • Organic contaminants (if yes, thermal desorption must be included in the treatment system)	NA(d)	NA	NA
	• Percentage of contaminated volume less than twice the PRG for cesium-137.	NA(d)	NA	NA
SW-9	Criterion: • Contaminants > PRG	NA	Yes	NA
	Enhancement: • Organic contaminants	NA	Yes	NA

NA - Not Applicable (d) - deviation from waste site group PRG - Preliminary Remediation Goals

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4.0 ALTERNATIVE DEVELOPMENT

This section identifies those waste sites in the 100-DR-1 Operable Unit that match completely with their corresponding waste site groups in the Process Document, and those waste sites that do not match.

For those sites that match completely, the site plugs directly into the analysis of alternatives for the waste site group conducted in the Process Document (see Section 1.4, Step 6a). The sites that meet this requirement include 116-D-7, 116-DR-9, 116-DR-1/2, 107-D/DR sludge trenches, 116-D-1A, 116-D-1B, 116-D-2A, 116-D-9, 118-D-4A, 118-D-4B, 118-D-18, 132-D-1, 132-D-2, and 132-D-3.

The sites that do not plug in directly (Process Document, Section 1.4, step 6b) can be divided into two groups. The first group includes sites that require enhancements to an alternative or an inclusion, or dismissal of an alternative as originally proposed. The sites that meet this requirement, and the applicable deviation, are as follows: 100-D/DR process effluent pipeline does not meet all of the applicability criteria for the pipeline group alternative identified in the Process Document. No contaminated soils have been identified around the pipelines, therefore the Removal/Treatment/Disposal Alternative no longer applies. Accordingly, this site deviates from the group because of changes in the applicable alternatives.

The second group of sites that do not plug in are those sites that require a significant modification to an alternative, such as changes in the excavation process or disposal options. Alternatives for sites included in this second group will require additional development. None of the sites within the 100-DR-1 Operable Unit fit into this second set, therefore, additional alternative development is not required.

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5.0 DETAILED ANALYSIS OF ALTERNATIVES

This section presents the detailed analysis of the Remedial Alternatives applicable to the individual waste sites within the 100-DR-1 Operable Unit. In the detailed analysis, each alternative is assessed against the evaluation criteria described in Section 5.1 of the Process Document. The detailed analysis provides a basis to compare the alternatives and to support a subsequent evaluation of the alternatives made by the decision makers in the remedy selection process.

The detailed analysis for the sites within the 100-DR-1 Operable Unit are presented in the following manner:

- The detailed analyses for those individual waste sites that do not deviate from the waste site groups are referenced to the group discussion presented in the Process Document.
- The detailed analyses for those individual waste sites that deviate from the waste site groups are discussed in Section 5.1.1.

5.1 SITE-SPECIFIC DETAILED ANALYSIS

Based on the comparison presented in Table G3-1, several of the individual waste sites within the 100-DR-1 Operable Unit plug into the waste site group alternatives; therefore, the detailed analysis for these individual waste sites can be referenced to the Process Document. These individual waste sites include 116-D-7, 116-DR-9, 116-DR-1/2, 107-D/DR sludge trenches, 116-D-1A, 116-D-1B, 116-D-2A, 116-D-9, 118-D-4A, 118-D-4B, 118-D-18, 132-D-1, 132-D-2, and 132-D-3.

The detailed analysis for the remaining waste site (100-D/DR pipelines) is discussed in the following sections. Table G5-1 summarizes the alternatives applicable to each waste site and whether the detailed analysis is covered in the Process Document or discussed below in Section 5.1.1. Tables G5-2 and G5-3 present the remediation costs and durations associated with all waste sites.

5.1.1 100-D/DR Pipeline

This section evaluates the 100-D/DR pipeline site against the CERCLA evaluation criteria. The Removal/Treatment/Disposal Alternative (SS-10) is applicable to sites that have contaminated soil. Current documentation indicates that the soil surrounding the 100-D/DR pipeline is not contaminated. Therefore, the soil surrounding the pipelines will not require remedial action. Because the deviation for this site is just an omission of an alternative, no evaluation is required.

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Alternatives		Technologies Included	Waste Site Group										
			116-D-7	116-DR-9	116-DR-1 116-DR-2	107-D/DR Sludge Trenches	116-D-1A	116-D-18	116-D-2A	116-D-9	Pipelines	118-D-4A 118-D-4B 118-D-18	132-D-1 132-D-2 132-D-3
No Action	SS-1 SW-1	None								P			P
Institutional Controls	SS-2 SW-2	Deed Restrictions											
		Groundwater Monitoring											
Containment	SS-3 SW-3	Surface Water Controls									P	P	
		Modified RCRA Barrier									P	P	
		Deed Restrictions									P	P	
		Groundwater Monitoring									P	P	
Removal, Disposal	SS-4 SW-4	Removal	P	P	P	P	P	P	P		P	P	
		Disposal	P	P	P	P	P	P	P		P	P	
In Situ Treatment	SS-8A	Surface Water Controls			P	P			P				
		In Situ Vitrification			P	P			P				
		Groundwater monitoring			P	P			P				
		Deed restrictions			P	P			P				
	SS-8B	Void Grouting									P		
		Modified RCRA Barrier									P		
		Surface Water Controls									P		
		Deed Restrictions									P		
		Groundwater Monitoring									P		
	SW-7	Dynamic Compaction										P	
		Modified RCRA Barrier										P	
		Surface Water Controls										P	
		Groundwater Monitoring										P	
		Deed Restrictions										P	
Removal, Treatment, Disposal	SS-10	Removal	P	P	P	P	P	P	P				
		Thermal Desorption											
		Soil Washing	P	P	P	P	P	P	P				
		Disposal	P	P	P	P	P	P	P				
	SW-9	Removal											
		Thermal Desorption											
		Compaction											
		ERDF Disposal											

P - Indicates the detailed analysis which is provided in the Process Document
blank - Technology does not apply to this Waste Site
RCRA - Resource Conservation and Recovery Act
ERDF - Environmental Restoration Disposal Facility

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Table G5-2. 100-DR-1 Site-Specific Alternative Costs.

Site	Containment			Removal/Disposal			In Situ Treatment			Removal/Treatment/Disposal		
	Capital	O&M	Present Worth	Capital	O&M	Present Worth	Capital	O&M	Present Worth	Capital	O&M	Present Worth
100-DR-1 OPERABLE UNIT												
116-D-7				$8.15E+07	$0.00E+00	$7.68E+07				$8.23E+07	$1.20E+07	$8.77E+07
107 D/DR SLUDGE TRENCHES #1				$1.69E+06	$0.00E+00	$1.61E+06	$3.53E+06	$2.24E+06	$5.49E+06	$2.08E+06	$2.69E+05	$2.24E+06
#2				$1.75E+06	$0.00E+00	$1.67E+06	$3.61E+06	$2.29E+06	$5.63E+06	$2.13E+06	$2.77E+05	$2.30E+06
#3				$1.72E+06	$0.00E+00	$1.64E+06	$3.58E+06	$2.27E+06	$5.57E+06	$2.11E+06	$2.73E+05	$2.28E+06
#4				$1.27E+06	$0.00E+00	$1.22E+06	$2.63E+06	$1.56E+06	$4.00E+06	$1.68E+06	$1.88E+05	$1.79E+06
#5				$1.31E+06	$0.00E+00	$1.25E+06	$2.85E+06	$1.78E+06	$4.42E+06	$1.72E+06	$2.07E+05	$1.84E+06
116-DR-9				$1.02E+08	$0.00E+00	$9.60E+07				$1.02E+08	$2.45E+07	$1.14E+08
116-D-1A				$4.69E+06	$0.00E+00	$4.47E+06				$4.88E+06	$9.50E+05	$5.57E+06
116-D-1B				$1.95E+06	$0.00E+00	$1.86E+06				$2.29E+06	$4.09E+05	$2.58E+06
116-DR-1/2				$1.39E+07	$0.00E+00	$1.33E+07	$3.10E+07	$2.30E+07	$4.88E+07	$1.37E+07	$3.48E+06	$1.63E+07
116-D-2A				$2.77E+05	$0.00E+00	$2.67E+05	$5.98E+05	$8.96E+04	$6.61E+05	$7.08E+05	$9.24E+03	$6.92E+05
116-D-9	Institutional Controls proposed at site											
100 D/DR PIPELINES	$3.23E+07	$1.48E+07	$3.81E+07	$9.03E+06	$0.00E+00	$8.61E+06	$3.68E+06	$0.00E+00	$3.51E+06			
116-D-4A	$1.22E+06	$5.14E+05	$1.45E+06	$2.50E+06	$0.00E+00	$2.38E+06	$1.43E+06	$5.76E+05	$1.69E+06	$2.51E+06	$1.37E+05	$2.53E+06
116-D-4B	$7.01E+05	$2.90E+05	$8.32E+05	$4.34E+05	$0.00E+00	$4.15E+05	$8.18E+05	$3.22E+05	$9.62E+05	$9.16E+05	$2.31E+04	$9.07E+05
116-D-10	$7.50E+05	$2.67E+05	$8.66E+05	$5.72E+05	$0.00E+00	$5.47E+05	$8.78E+05	$2.95E+05	$1.00E+06	$1.02E+06	$3.08E+04	$1.02E+06
132-D-1	No interim action proposed at site											
132-D-2	No interim action proposed at site											
132-D-3	No interim action proposed at site											

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Table G5-3. 100-DR-1 Site-Specific Alternative Durations.

Site	Containment Duration (yrs)	Removal/Disposal Duration (yrs)	In Situ Treatment Duration (yrs)	Removal/Treatment/Disposal Duration (yrs)
100-DR-1 OPERABLE UNIT				
116-D-7		1.2		2.1
107 D/DR SLUDGE TRENCHES #1		0.1	0.4	0.1
#2		0.1	0.4	0.1
#3		0.1	0.4	0.1
#4		0.1	0.3	0.1
#5		0.1	0.3	0.1
116-DR-9		1.4		3.2
116-D-1A		0.2		0.3
116-D-1B		0.1		0.1
116-DR-1/2		0.4	3.1	0.5
116-D-2A		0.1	0.1	0.1
116-D-9	Institutional Controls proposed at site			
100 D/DR PIPELINES	1.6	1.0	0.1	
118-D-4A	0.1	0.1	0.1	0.1
118-D-4B	0.1	0.1	0.1	0.1
118-D-18	0.1	0.1	0.1	0.1
132-D-1	No interim action proposed at site			
132-D-2	No interim action proposed at site			
132-D-3	No interim action proposed at site			

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6.0 COMPARATIVE ANALYSIS

This section presents the comparative analysis of Remedial Alternatives that involves evaluation of the relative performance of each alternative with respect to the evaluation criteria presented in Section 5.0. This comparison identifies the advantages and disadvantages of each alternative so that key tradeoffs can be identified.

Following the methodology of the Process Document, the comparative analysis of the 100-DR-1 alternatives is presented in quantitative format (Tables G6-1 through G6-7). The tables present the alternatives applicable to each waste site and a comparison of the relative differences between each alternative. The comparison identifies the relative rank of the alternative (relative to other applicable alternatives) along with the cost, and a discussion of its specific advantages and disadvantages.[1]

The quantitative comparison tables provide rank for each alternative, as well as separate rankings for the five criteria evaluated. Tables G6-1 through G6-7 summarize the comparative analysis of the applicable alternatives for each waste site.

No action is identified as the only applicable alternative for the 116-D-9 seal pit crib (see Section 5.0 of this document and the Process Document). Because there are no other alternatives to compare against, the site is not included in the comparative analysis. Likewise, the Process Document identifies no action for the decontamination and decommissioning groups. Thus, these sites (132-D-1, 132-D-2, and 132-D-3) are not presented in the following tables.

6.1 QUANTITATIVE COMPARISON OF REMEDIAL ALTERNATIVES

6.1.1 Retention Basins

The comparative analysis for retention basins ranked Removal/Disposal ahead of Removal/Treatment/Disposal Alternative. The long-term evaluation criteria and reduction in toxicity for 116-D-7 and 116-DR-9 retention basins scores higher for Removal/Treatment/ Disposal; however, all the other evaluation criteria (short-term effectiveness, implementability, and cost) score higher for the Removal/Disposal Alternative. The comparative analysis results are shown in Tables G6-1 and G6-2.

6.1.2 Process Effluent Trenches

The Removal/Disposal, In Situ Vitrification, and Removal/Treatment/Disposal Alternatives were considered for 116-DR-1 and 116-DR-2 process effluent trenches. In the long-term evaluation criteria, Removal/Treatment/Disposal scored higher than the other two alternatives. In the reduction in toxicity criteria In Situ Vitrification scored the highest. In the rest of the evaluation criteria, Removal/Disposal received equal or higher scores and is

[1] Estimates of duration for each alternative are presented in Section 5.0 Table 5-1.

the highest ranked alternative. The comparative analysis results are shown in Tables G6-3 and G6-4.

6.1.3 Sludge Trenches

There are five sludge trenches in the 100-DR-1 Operable Unit. These sludge trenches were evaluated for Removal/Disposal, In Situ Vitrification, and Removal/Treatment/Disposal Alternatives. The Removal/Treatment/Disposal scored highest for the long-term effectiveness while In Situ Vitrification was better in reduction in toxicity evaluation criteria. For short-term, implementability, cost criteria, and Removal/Disposal scored equal or highest and is the highest ranked alternative. The comparative analysis results are shown in Table G6-5.

6.1.4 Fuel Storage Basin Trenches

The 116-D-1A and 116-D-1B fuel storage basin trenches were evaluated for Removal/Disposal and Removal/Treatment/Disposal Alternatives. The Removal/Treatment/Disposal Alternative scored higher in long-term effectiveness and reduction in toxicity criteria. However, for the short-term effectiveness, implementability and cost criteria, the highest ranking alternative was Removal/Disposal and overall scored two points higher than the Removal/Treatment/Disposal Alternative. The comparative analysis results are shown in Tables G6-6 and G6-7.

6.1.5 Pluto Crib

The Removal/Disposal, In Situ Vitrification, and Removal/Treatment/Disposal Alternatives were considered for the 116-D-2A pluto crib. The Removal/Treatment/Disposal scored highest for long-term effectiveness. For the reduction in toxicity, In Situ Vitrification was better than the Removal/Disposal or Removal/Treatment/Disposal Alternatives. The Removal/Disposal scored higher for short-term effectiveness, implementability and cost criteria and was overall the highest ranked alternative for this pluto crib. The comparative analysis results are shown in Table G6-8.

6.1.6 Buried Pipelines

The Containment, Removal/Disposal, and In Situ Grouting were considered as Remedial Alternatives for the buried pipelines in 100-DR-1 Operable Unit. For the short-term criteria, the containment scored the highest. For cost, the In Situ Grouting was the best alternative. For the other (long-term, reduction in toxicity, and implementability) criteria, the Removal/Disposal scored the highest and is the overall highest ranked Remedial Alternative for the buried pipelines. The Removal/Treatment/Disposal Alternative (SS-10) is applicable to sites that have contaminated soil. Current documentation indicates that the soil surrounding the pipelines is not contaminated, therefore, this alternative was not considered. The comparative analysis results are shown in Table G6-9.

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6.1.7 Burial Grounds

There are three burial grounds in 100-DR-1 Operable Unit, which were evaluated for remediation alternatives. The four alternatives considered in this evaluation were Containment, Removal/Disposal, In Situ Compaction, and Removal/Treatment/Disposal.

6.1.8 118-D-4A Burial Ground

The overall highest ranked alternative for 118-D-4A burial ground was Containment, followed by Removal/Treatment/Disposal, In Situ compaction, and Removal/Disposal. In Situ compaction and Removal/Treatment/Disposal are tied. In comparison, all four alternatives are only 2.5 apart in total scores. For long-term effectiveness and reduction in toxicity criteria, Removal/Treatment/Disposal Alternative scored the highest. For short-term and cost criteria, the Containment Alternative ranked higher than the other three alternatives. For implementability, Containment and Removal/Disposal were equal and better than the rest of the criteria. The comparative analysis results are shown in Table G6-10.

6.1.9 118-D-4B Burial Ground

Removal/Disposal scored the highest for cost criteria and was the overall highest ranked Remedial Alternative. The Removal/Treatment/Disposal Alternative ranked higher for long-term effectiveness and reduction in toxicity criteria. For short-term effectiveness, Containment Alternative ranked the highest. For implementability, Containment and Removal/Disposal were equal and better than others. The comparative analysis results are shown in Table G6-11.

6.1.10 118-D-18 Burial Ground

The overall highest ranked Remedial Alternative for 118-D-18 burial ground was Removal/Disposal. For long-term effectiveness and reduction in toxicity criteria, the Removal/Treatment/ Disposal ranked the highest. For short-term effectiveness, Containment was the best alternative. For implementability, Containment and Removal/Disposal were equal and better than others, while Removal/Disposal scored the highest for cost criteria. The comparative analysis results are shown in Table G6-12.

Table G6-1. Quantitative Comparison of Evaluation Criteria for 116-D-7 Retention Basin.

CERCLA Evaluation Criteria	Remedial Alternatives					
	Removal/Disposal			Removal/Treatment/Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	7.00	7.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	4.00	2.00	0.50	5.00	2.5
Short-term Effectiveness	0.50	6.00	3.00	0.50	3.00	1.50
Implementability	1.00	9.00	9.00	1.00	5.00	5.00
Cost	1.00	10.00	10.00	1.00	8.00	8.00
Total Rank[b]			31.0			26.0

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

Table G6-2. Quantitative Comparison of Evaluation Criteria for 116-DR-9 Retention Basin.

CERCLA Evaluation Criteria	Remedial Alternatives					
	Removal/Disposal			Removal/Treatment/Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	7.00	7.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	4.00	2.00	0.50	5.00	2.5
Short-term Effectiveness	0.50	6.00	3.00	0.50	3.00	1.50
Implementability	1.00	9.00	9.00	1.00	5.00	5.00
Cost	1.00	10.00	10.00	1.00	8.00	8.00
Total Rank[b]			31.0			26.0

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

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Table G6-3. Quantitative Comparison of Evaluation Criteria for 116-DR-1 Process Effluent Trenches.

CERCLA Evaluation Criteria	Remedial Alternatives								
	Removal/Disposal			In Situ Vitrification			Removal/Treatment/ Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	7.00	7.00	1.00	4.00	4.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	3.00	1.5	0.50	7.00	3.5	0.50	5.00	2.5
Short-term Effectiveness	0.50	7.00	3.50	0.50	7.00	3.50	0.50	3.00	1.50
Implementability	1.00	7.00	7.00	1.00	2.00	2.00	1.00	5.00	5.00
Cost	1.00	10.00	10.00	1.00	3.00	3.00	1.00	8.00	8.00
Total Rank[b]			29.0			16.0			26.0

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

Table G6-4. Quantitative Comparison of Evaluation Criteria for 116-DR-2 Process Effluent Trenches.

CERCLA Evaluation Criteria	Remedial Alternatives								
	Removal/Disposal			In Situ Vitrification			Removal/Treatment/ Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	7.00	7.00	1.00	4.00	4.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	3.00	1.5	0.50	7.00	3.5	0.50	5.00	2.5
Short-term Effectiveness	0.50	7.00	3.50	0.50	7.00	3.50	0.50	3.00	1.50
Implementability	1.00	7.00	7.00	1.00	2.00	2.00	1.00	5.00	5.00
Cost	1.00	10.00	10.00	1.00	3.00	3.00	1.00	8.00	8.00
Total Rank[b]			29.0			16.0			26.0

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

Table G6-5. Quantitative Comparison of Evaluation Criteria for Sludge Trenches (1, 2, 3, 4, 5).

CERCLA Evaluation Criteria	Remedial Alternatives								
	Removal/Disposal			In Situ Vitrification			Removal/Treatment/ Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	7.00	7.00	1.00	4.00	4.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	3.00	1.5	0.50	7.00	3.5	0.50	5.00	2.5
Short-term Effectiveness	0.50	7.00	3.50	0.50	7.00	3.50	0.50	5.00	2.50
Implementability	1.00	7.00	7.00	1.00	3.00	3.00	1.00	5.00	5.00
Cost	1.00	10.00	10.00	1.00	3.00	3.00	1.00	7.00	7.00
Total Rank[b]			29.0			17.0			26.0

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

Table G6-6. Quantitative Comparison of Evaluation Criteria for 116-D-1A Fuel Storage Basin Trench.

CERCLA Evaluation Criteria	Remedial Alternatives					
	Removal/Disposal			Removal/Treatment/Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	7.00	7.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	3.00	1.5	0.50	5.00	2.5
Short-term Effectiveness	0.50	7.00	3.50	0.50	5.00	2.50
Implementability	1.00	7.00	7.00	1.00	5.00	5.00
Cost	1.00	10.00	10.00	1.00	8.00	8.00
Total Rank[b]			29.0			27.0

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

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Table G6-7. Quantitative Comparison of Evaluation Criteria for 116-D-1B Fuel Storage Basin Trench.

CERCLA Evaluation Criteria	Remedial Alternatives					
	Removal/Disposal			Removal/Treatment/Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	7.00	7.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	3.00	1.5	0.50	5.00	2.5
Short-term Effectiveness	0.50	7.00	3.50	0.50	5.00	2.50
Implementability	1.00	7.00	7.00	1.00	5.00	5.00
Cost	1.00	10.00	10.00	1.00	7.00	7.00
Total Rank[b]			29.0			26.0

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

Table G6-8. Quantitative Comparison of Evaluation Criteria for 116-D-2A Pluto Crib.

CERCLA Evaluation Criteria	Remedial Alternatives								
	Removal/Disposal			In Situ Vitrification			Removal/Treatment/ Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	7.00	7.00	1.00	4.00	4.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	3.00	1.5	0.50	7.00	3.5	0.50	5.00	2.5
Short-term Effectiveness	0.50	8.00	4.00	0.50	7.00	3.50	0.50	6.00	3.00
Implementability	1.00	8.00	8.00	1.00	4.00	4.00	1.00	6.00	6.00
Cost	1.00	10.00	10.00	1.00	4.00	4.00	1.00	4.00	4.00
Total Rank[b]			30.5			19.0			24.5

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

Table G6-9. Quantitative Comparison of Evaluation Criteria for Buried Process Effluent Pipelines.

CERCLA Evaluation Criteria	Remedial Alternatives								
	Containment			Removal/Disposal			In Situ Grouting		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	2.00	2.00	1.00	7.00	7.00	1.00	3.00	3.00
Reduction of Mobility or Volume	0.50	1.00	0.50	0.50	3.00	1.50	0.50	2.00	1.0
Short-term Effectiveness	0.50	7.00	3.50	0.50	6.00	3.00	0.50	6.00	3.00
Implementability	1.00	3.00	3.00	1.00	7.00	7.00	1.00	2.00	2.00
Cost	1.00	1.00	1.00	1.00	4.00	4.00	1.00	10.00	10.00
Total Rank[b]			10.0			22.5			19.0

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

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Table G6-10. Quantitative Comparison of Evaluation Criteria for 118-D-4A Burial Ground

CERCLA Evaluation Criteria	Remedial Alternatives											
	Containment			Removal/Disposal			In Situ Compaction			Removal/Treatment/Disposal		
	Weight	Score	Rank[(a)]	Weight	Score	Rank[(a)]	Weight	Score	Rank[(a)]	Weight	Score	Rank[(a)]
Long-term Effectiveness	1.00	3.00	3.00	1.00	7.00	7.00	1.00	4.00	4.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	2.00	1.0	0.50	3.00	1.5	0.50	2.00	1.0	0.50	5.00	2.5
Short-term Effectiveness	0.50	9.00	4.50	0.50	3.00	1.50	0.50	7.00	3.50	0.50	2.00	1.00
Implementability	1.00	5.00	5.00	1.00	5.00	5.00	1.00	4.00	4.00	1.00	3.00	3.00
Cost	1.00	10.00	10.00	1.00	6.00	6.00	1.00	9.00	9.00	1.00	6.00	6.00
Total Rank[(b)]			23.5			21.0			21.5			21.5

Table G6-11. Quantitative Comparison of Evaluation Criteria for 118-D-4B Burial Ground.

CERCLA Evaluation Criteria	Remedial Alternatives											
	Containment			Removal/Disposal			In Situ Compaction			Removal/Treatment/Disposal		
	Weight	Score	Rank[(a)]	Weight	Score	Rank[(a)]	Weight	Score	Rank[(a)]	Weight	Score	Rank[(a)]
Long-term Effectiveness	1.00	3.00	3.00	1.00	7.00	7.00	1.00	4.00	4.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	2.00	1.0	0.50	3.00	1.5	0.50	2.00	1.0	0.50	5.00	2.5
Short-term Effectiveness	0.50	9.00	4.50	0.50	3.00	1.50	0.50	7.00	3.50	0.50	2.00	1.00
Implementability	1.00	5.00	5.00	1.00	5.00	5.00	1.00	4.00	4.00	1.00	3.00	3.00
Cost	1.00	5.00	5.00	1.00	10.00	10.00	1.00	4.00	4.00	1.00	5.00	5.00
Total Rank[(b)]			18.5			25.0			16.5			21.5

Table G6-12. Quantitative Comparison of Evaluation Criteria for 118-D-18 Burial Grounds.

CERCLA Evaluation Criteria	Remedial Alternatives											
	Containment			Removal/Disposal			In Situ Compaction			Removal/Treatment/Disposal		
	Weight	Score	Rank[(a)]	Weight	Score	Rank[(a)]	Weight	Score	Rank[(a)]	Weight	Score	Rank[(a)]
Long-term Effectiveness	1.00	3.00	3.00	1.00	7.00	7.00	1.00	4.00	4.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	2.00	1.0	0.50	3.00	1.5	0.50	2.00	1.0	0.50	5.00	2.5
Short-term Effectiveness	0.50	9.00	4.50	0.50	3.00	1.50	0.50	7.00	3.50	0.50	2.00	1.00
Implementability	1.00	5.00	5.00	1.00	5.00	5.00	1.00	4.00	4.00	1.00	3.00	3.00
Cost	1.00	6.00	6.00	1.00	10.00	10.00	1.00	2.00	2.00	1.00	5.00	5.00
Total Rank[(b)]			19.5			25.0			14.5			20.5

(a) Rank = weight x score
(b) Total Rank = sum of individual rankings

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7.0 COMPARATIVE ANALYSIS FOR REVISED FREQUENT USE SCENARIO

As discussed in the Introduction of this Appendix, the detailed and comparative analyses performed in Sections 5.0 and 6.0 of the Process Document and this FFS Appendix were based on meeting human health risk-based goals assuming occasional use of the land and soil remediation to support frequent use of groundwater. This scenario is referred to as the baseline scenario. Based on the recent Tri-Party Agreement decision to use Washington's MTCA B regulations and EPA's proposed 15 mrem/yr radiation exposure criteria to establish soil remediation goals, an assessment was conducted to see how this change in cleanup goals effects the analysis of alternatives. The revised frequent use scenario (MTCA B/15 mrem/yr), discussed in the Sensitivity Analysis (Appendix D, Attachment 6), indicates that the revised frequent use scenario imposes two significant changes on the comparative analysis of alternatives. These are as follows:

1. The In Situ and Containment Alternatives are no longer appropriate for interim actions at the 100 Areas because these alternatives leave wastes at the site and thereby preclude several potential future uses. Interim actions, based on the recent Tri-Party Agreement decision, should be consistent with both frequent and occasional use of the land.

2. The revised frequent use scenario potentially requires less excavation than the baseline scenario. Therefore, the costs of the Removal/Disposal and Removal/Treatment/Disposal Alternatives are reduced 32 and 30%, respectively, as compared to the baseline scenario. The baseline scenario costs are presented in Appendix B of the Process Document, and the costs and volumes for the revised frequent use scenario are presented in the Sensitivity Analysis (Appendix D).

With the elimination of the Containment and In Situ Treatment Alternatives, the Removal/Disposal and Removal/Treatment/Disposal Alternatives become the two principal Remedial Alternatives. The change from the baseline scenario to the revised frequent use scenario influences these two alternatives in similar ways. Therefore, there is very little effect on the key discriminators used for the comparative analysis. This means that the comparative analysis of these two alternatives under the baseline scenario changes only slightly by switching to the revised frequent use scenario. The next two subsections evaluate how the revised frequent use scenario changes the results of the original analysis of alternatives. The evaluation is based on information presented in Appendix D, the Process Document, and earlier sections of this FFS Appendix.

7.1 INFLUENCE OF THE REVISED FREQUENT USE CLEANUP GOALS ON THE 100-DR-1 FFS

The development of the Remedial Alternatives in the 100 Area Feasibility Study Phases 1 and 2 (DOE-RL 1993a) and the Process Document are not influenced by the change in cleanup goals, so the number and types of Remedial Alternatives stay the same. Likewise, the plug-in approach is still directly applicable for either the baseline or the revised frequent use scenarios.

The detailed analysis of the Removal/Disposal and Removal/Treatment/Disposal Alternatives in the Process Document (Section 5.0) is influenced only slightly by the change in cleanup goals (less excavation is required by the revised frequent use scenario); therefore, there is no change in the assessment of these alternatives with regards to the CERCLA evaluation criteria and NEPA issues. The potential adverse effects of the Removal/Disposal and Removal/Treatment/Disposal Alternatives on workers, future site uses, and the environment are also much the same under the revised frequent use scenario as they are under the baseline scenario. Therefore, the detailed analysis of alternatives in the Process Document and this 100-DR-1 FFS Appendix remain valid.

The comparative analysis in Section 6.0 of this FFS Appendix (see Tables G6-1 through G6-12) requires changes because (1) the In Situ and Containment Alternatives drop out and (2) the ranking based on costs must be recalculated. In most cases the recalculation of costs did not change the relative ranking of the alternatives. That is, the alternative with the highest total rank under the baseline scenario also generally received the highest rank under the revised frequent use scenario. The following subsection describes how the results of the comparative analysis change, in comparison to the results in Section 6.0 of the Process Document and this FFS Appendix, due to the change in the cleanup goals.

7.2 REVISED FREQUENT USE SCENARIO QUANTITATIVE COMPARISON OF REMEDIAL ALTERNATIVES

7.2.1 116-D-7 and 116-DR-9 Retention Basins

The Remove/Dispose and Remove/Treat/Dispose Alternatives are the only alternatives applicable to these retention basins. The scoring and ranking as applied in the Process Document and in this FFS Appendix are still valid, except for costs. The cost reduction of 32% and 30% for Remove/Dispose and Remove/Treat/Dispose, respectively, changes the score of the cost category to 10 and 9, respectively. The reduction in excavation does not change the relative advantages and disadvantages of the alternatives. The comparative analysis, tables based on the new remediation concept for 116-D-7, are given in Table G7-1 and for 116-DR-9 are given in Table G7-2.

7.2.2 116-DR-1 and 116-DR-2 Process Effluent Trenches

With the elimination of ISV as an alternative for the 116-DR-1 and 116-DR-2 process effluent trenches, now only the Remove/Dispose and Remove/Treat/Dispose Alternatives are applicable to these waste sites. The scoring and ranking, as applied in the Process Document and Section 6.0 of this FFS, are still valid except for cost. The cost reduction of 32% and 30% for Remove/Dispose and Remove/Treat/Dispose, respectively, does not change the score of the cost category. The comparative analysis tables, based on the new remediation concept for 116-DR-1 and 116-DR-2, are given in Tables G7-3 and G7-4.

7.2.3 107 D/DR Sludge Trenches

With the elimination of ISV, the 107 D/DR sludge trenches (1 through 5) were evaluated only for Remove/Dispose and Remove/Treat/Dispose. The scoring and ranking, as applied in the Process Document and Section 6.0 of this FFS, are still valid. The cost reduction factors discussed above resulted in no changes to the score of the cost category. The comparative analysis table, based on the new remediation concept for 107 D/DR trenches, is given in Table G7-5.

7.2.4 116-D-1A and 116-D-1B Fuel Storage Basin Trenches

With the elimination of the ISV and Containment Alternatives, the Remove/Dispose and Remove/Treat/Dispose Alternatives are the only alternatives applicable to the 116-D-1A and 116-D-1B Storage Basin Trenches. The scoring and ranking, as applied in the Process Document and in this FFS Appendix, are still valid except for costs. The cost reduction of 32% and 30% for Remove/Dispose and Remove/Treat/Dispose, respectively, does not change the score of the cost category. The reduction in excavation does not change the relative advantages and disadvantages of the alternatives. The comparative analysis criteria, based on the new remediation concept for 116-D-1A, are given in Table G7-6 and for 116-D-1B are given in Table G7-7.

7.2.5 116-D-2A Pluto Crib

With the elimination of ISV and containment as an alternative for the 116-D-2A pluto crib, now only the Remove/Dispose and Remove/Treat/Dispose Alternatives are applicable to this waste site. The scoring and ranking, as applied in the Process Document and Section 6.0 of this FFS, are still valid except for cost. The cost reduction of 32% and 30% for Remove/Dispose and Remove/Treat/Dispose, respectively, does not change the score of the cost category. The comparative analysis table, based on new remediation concept for 116-D-2A pluto crib, is given in Table G7-8.

7.2.6 100-D Buried Process Effluent Pipelines

With the elimination of the ISV and Containment Alternatives for the 100-D pipelines, Remove/Dispose is the only viable alternative to be considered.

7.2.7 100-D Burial Grounds

With the elimination of ISV and containment alternatives, Remove/Dispose and Remove/Treat/Dispose are the only alternatives to be considered. The scoring and ranking, as applied in the Process Document and Section 6.0 of this FFS, are still valid except for cost. The Remove/Dispose Alternative is the highest ranked alternative for the 118-D-4A, 118-D-4B, and 118-D-18 burial grounds. The comparative analysis tables based on new remediation concept for the burial grounds, are given in Tables G7-9, G7-10, and G7-11, respectively.

7.2.8 Comparative Analysis Summary

The revised frequent use scenario comparative analysis ranks Remove/Dispose Alternative as the highest of all the alternatives considered for the 100-DR-1 IRM sites. See Tables G7-1 through G7-11.

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Table G7-1. New Remediation Concept Quantitative Comparison of Evaluation Criteria for 116-D-7 Retention Basin.

CERCLA Evaluation Criteria	Remedial Alternatives					
	Removal/Disposal			Removal/Treatment/Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	7.00	7.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	4.00	2.00	0.50	5.00	2.5
Short-term Effectiveness	0.50	6.00	3.00	0.50	3.00	1.50
Implementability	1.00	9.00	9.00	1.00	5.00	5.00
Cost	1.00	10.00	10.00	1.00	9.00	9.00
Total Rank[b]			31.0			27.0

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

Table G7-2. New Remediation Concept Quantitative Comparison of Evaluation Criteria for 116-DR-9 Retention Basin.

CERCLA Evaluation Criteria	Remedial Alternatives					
	Removal/Disposal			Removal/Treatment/Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	7.00	7.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	4.00	2.00	0.50	5.00	2.5
Short-term Effectiveness	0.50	6.00	3.00	0.50	3.00	1.50
Implementability	1.00	9.00	9.00	1.00	5.00	5.00
Cost	1.00	10.00	10.00	1.00	8.00	8.00
Total Rank[b]			31.0			26.0

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

Table G7-3. New Remediation Concept Quantitative Comparison of Evaluation Criteria for 116-DR-1 Process Effluent Trenches.

CERCLA Evaluation Criteria	Remedial Alternatives					
	Removal/Disposal			Removal/Treatment/ Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	7.00	7.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	3.00	1.5	0.50	5.00	2.5
Short-term Effectiveness	0.50	7.00	3.50	0.50	3.00	1.50
Implementability	1.00	7.00	7.00	1.00	5.00	5.00
Cost	1.00	10.00	10.00	1.00	8.00	8.00
Total Rank[b]			29.0			26.0

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

Table G7-4. New Remediation Concept Quantitative Comparison of Evaluation Criteria for 116-DR-2 Process Effluent Trenches.

CERCLA Evaluation Criteria	Remedial Alternatives					
	Removal/Disposal			Removal/Treatment/ Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	7.00	7.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	3.00	1.5	0.50	5.00	2.5
Short-term Effectiveness	0.50	7.00	3.50	0.50	3.00	1.50
Implementability	1.00	7.00	7.00	1.00	5.00	5.00
Cost	1.00	10.00	10.00	1.00	8.00	8.00
Total Rank[b]			29.0			26.0

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

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Table G7-5. New Remediation Concept Quantitative Comparison of Evaluation Criteria for Sludge Trenches (1, 2, 3, 4, 5).

CERCLA Evaluation Criteria	Remedial Alternatives					
	Removal/Disposal			Removal/Treatment/ Disposal		
	Weight	Score	Rank[(a)]	Weight	Score	Rank[(a)]
Long-term Effectiveness	1.00	7.00	7.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	3.00	1.5	0.50	5.00	2.5
Short-term Effectiveness	0.50	7.00	3.50	0.50	5.00	2.50
Implementability	1.00	7.00	7.00	1.00	5.00	5.00
Cost	1.00	10.00	10.00	1.00	7.00	7.00
Total Rank[(b)]			29.0			26.0

[(a)]Rank = weight x score
[(b)]Total Rank = sum of individual rankings

Table G7-6. New Remediation Concept Quantitative Comparison of Evaluation Criteria for 116-D-1A Fuel Storage Basin Trench.

CERCLA Evaluation Criteria	Remedial Alternatives					
	Removal/Disposal			Removal/Treatment/Disposal		
	Weight	Score	Rank[(a)]	Weight	Score	Rank[(a)]
Long-term Effectiveness	1.00	7.00	7.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	3.00	1.5	0.50	5.00	2.5
Short-term Effectiveness	0.50	7.00	3.50	0.50	5.00	2.50
Implementability	1.00	7.00	7.00	1.00	5.00	5.00
Cost	1.00	10.00	10.00	1.00	8.00	8.00
Total Rank[(b)]			29.0			27.0

[(a)]Rank = weight x score
[(b)]Total Rank = sum of individual rankings

Table G7-7. New Remediation Concept Quantitative Comparison of Evaluation Criteria for 116-D-1B Fuel Storage Basin Trench.

CERCLA Evaluation Criteria	Remedial Alternatives					
	Removal/Disposal			Removal/Treatment/Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	7.00	7.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	3.00	1.5	0.50	5.00	2.5
Short-term Effectiveness	0.50	7.00	3.50	0.50	5.00	2.50
Implementability	1.00	7.00	7.00	1.00	5.00	5.00
Cost	1.00	10.00	10.00	1.00	7.00	7.00
Total Rank[b]			29.0			26.0

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

Table G7-8. New Remediation Concept Quantitative Comparison of Evaluation Criteria for 116-D-2A Pluto Crib.

CERCLA Evaluation Criteria	Remedial Alternatives					
	Removal/Disposal			Removal/Treatment/Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	7.00	7.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	3.00	1.5	0.50	5.00	2.5
Short-term Effectiveness	0.50	8.00	4.00	0.50	6.00	3.00
Implementability	1.00	8.00	8.00	1.00	6.00	6.00
Cost	1.00	10.00	10.00	1.00	4.00	4.00
Total Rank[b]			30.5			24.5

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

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Table G7-9. New Remediation Concept Quantitative Comparison of Evaluation Criteria for 118-D-4A Burial Ground.

CERCLA Evaluation Criteria	Removal/Disposal			Removal/Treatment/Disposal		
	Weight	Score	Rank[(a)]	Weight	Score	Rank[(a)]
Long-term Effectiveness	1.00	7.00	7.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	3.00	1.5	0.50	5.00	2.5
Short-term Effectiveness	0.50	3.00	1.50	0.50	2.00	1.00
Implementability	1.00	5.00	5.00	1.00	3.00	3.00
Cost	1.00	10.00	10.00	1.00	9.00	9.00
Total Rank[(b)]			25.0			24.5

[(a)]Rank = weight x score
[(b)]Total Rank = sum of individual rankings

Table G7-10. New Remediation Concept Quantitative Comparison of Evaluation Criteria for 118-D-4B Burial Ground.

CERCLA Evaluation Criteria	Removal/Disposal			Removal/Treatment/Disposal		
	Weight	Score	Rank[(a)]	Weight	Score	Rank[(a)]
Long-term Effectiveness	1.00	7.00	7.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	3.00	1.50	0.50	5.00	2.5
Short-term Effectiveness	0.50	3.00	1.50	0.50	2.00	1.00
Implementability	1.00	5.00	5.00	1.00	3.00	3.00
Cost	1.00	10.00	10.00	1.00	4.00	4.00
Total Rank[(b)]			25.0			19.5

[(a)]Rank = weight x score
[(b)]Total Rank = sum of individual rankings

Table G7-11. New Remediation Concept Quantitative Comparison of Evaluation Criteria for 118-D-18 Burial Grounds.

CERCLA Evaluation Criteria	Removal/Disposal			Removal/Treatment/Disposal		
	Weight	Score	Rank[a]	Weight	Score	Rank[a]
Long-term Effectiveness	1.00	7.00	7.00	1.00	9.00	9.00
Reduction of Mobility or Volume	0.50	3.00	1.5	0.50	5.00	2.5
Short-term Effectiveness	0.50	3.00	1.50	0.50	2.00	1.00
Implementability	1.00	5.00	5.00	1.00	3.00	3.00
Cost	1.00	10.00	10.00	1.00	5.00	5.00
Total Rank[b]			25.0			20.5

[a]Rank = weight x score
[b]Total Rank = sum of individual rankings

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ATTACHMENT 1

100-DR-1 OPERABLE UNIT WASTE SITE VOLUME ESTIMATES

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Volume Estimate
100-DR-1 Operable Unit

OBJECTIVE:

Provide estimates of:

- The volume of contaminated materials within selected waste sites in the 100-DR-1 Operable Unit.
- The volume of materials that will need to be excavated to remove the contaminated materials.
- The areal extent of contamination.

Estimates are provided for the following waste sites:

Site Number	Site Name	Page
116-D-1A	105-D Storage Basin Trench No. 1	GA1-6
116-D-1B	105-D Storage Basin Trench No. 2	GA1-8
116-D-2	105-D Pluto Crib	GA1-10
116-D-7	107-D Retention Basin	GA1-12
116-DR-1 & 2	107-DR Liquid Waste Trench No. 1 & 2	GA1-14
116-D-9	117-D Seal Crib	GA1-17
116-DR-9	107-DR Retention Basin	GA1-18
132-D-1	115-D Gas Recirculation Building	GA1-20
132-D-2	117-D Filter Building	GA1-21
132-D-3	Effluent Pumping Station	GA1-22
	107-D/DR Sludge Disposal Trench No. 1	GA1-23
	107-D/DR Sludge Disposal Trench No. 2	GA1-25
	107-D/DR Sludge Disposal Trench No. 3	GA1-27
	107-D/DR Sludge Disposal Trench No. 4	GA1-29
	107-D/DR Sludge Disposal Trench No. 5	GA1-31
	118-D4-A Burial Ground	GA1-33
	118-D4-B Burial Ground	GA1-35
	118-18 Burial Ground	GA1-37
Pipelines	107-D & 107-DR Process Effluent Pipelines	GA1-39

Volume Estimate
100-DR-1 Operable Unit

METHOD:

The following steps are used to calculate volumes and areas for each waste site:

- Estimate the dimensions of each waste site.
- Estimate the location of the site.
- Estimate the extent of contamination present at each site.
- Estimate the extent of the excavation necessary to remove the contamination present.
- Calculate the volume of contamination present. the volume of material to be removed, and the areal extent of contamination.

Waste Site Dimensions -
Dimensions of the waste site are derived from all pertinent references. The reference used is noted in brackets [].

Waste Site Location -
Location of the waste site is derived from pertinent references, confirmed by field visit. The specific reference or method used to locate each site is discussed in a separate brief [9]. Coordinates for each waste site are converted to Washington State coordinates [9]. Resulting Washington State coordinates are presented herein.

Contaminated Volume Dimensions -
The extent of contamination present at the waste site is estimated from analytical data that exists for the site. The data used, assumptions made, and method for estimating extent is discussed in a separate brief [10]. Dimensions are summarized herein.

Excavated Volume Dimensions -
The extent of the excavation necessary to remove the contamination is based on a 1.5 H : 1.0 V excavation slope with the extent of contamination at depth serving as the bottom of the excavation.

Volume and Area Calculations -
The above information is used to construct a digital terrain model of each site within the computer program AutoCad. The computer program DCA is then used to calculate volumes and areas for the waste site.

ASSUMPTIONS:

The following assumptions were used to locate and/or provide dimensions for a waste site if no other data exists. See Reference 10 for assumptions concerning extent of contamination and Reference 9 for assumptions concerning location of the waste site.

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Volume Estimate
100-DR-1 Operable Unit

ASSUMPTIONS (continued):

Burial Grounds -

- Burial ground dimensions are 6 m (20 ft) wide at the bottom, 6 m (20 ft) deep, and have 1.0 H : 1.0 V side slopes.
- Five feet of additional cover was provided.
- Burial grounds were completely filled.

Liquid Waste Sites -

- Trenches were built with 1.0 H : 1.0 V side slopes.
- Tops of cribs are 1.9 m (6 ft) below grade.

The following assumptions were used in calculating volumes and areas:

- No site interferences or overlaps are considered, volumes and areas are calculated for each waste site separately.

All depths are below grade unless otherwise noted.

REFERENCES:

1 DOE-RL, 1994, *Hanford Site Waste Information Data System* (WIDS), U.S. Department of Energy, Richland Operations Office, Richland, Washington.

2 100-D Area Technical Baseline Report

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9 IT Corporation, 1994, "100-DR-1 Waste Site Contamination Extent," IT Corporation Calculation Brief, Project Number 199806.406.

Volume Estimate
100-DR-1 Operable Unit

SITE NUMBER: 116-D-1A
SITE NAME: 105-D Storage Basin Trench No. 1

WASTE SITE DIMENSIONS:

Length - 39.6 m (130 ft) along the bottom. 43.3 m (142 ft) at surface [1]
Width - 3.1 m (10 ft) along the bottom, 6.7 m (22 ft) at surface [1]
Depth - 1.8 m (6 ft) [1]
Slopes - 1.0 H : 1.0 V
Orientation - East-West lengthwise

Site was backfilled to 0.6 m (2 ft) above existing grade [2].

CONTAMINATED VOLUME DIMENSIONS:

Trench was filled to grade with liquids, side slopes, and substrate and are contaminated from surface to 56 ft bls [10].

Length - 43.3 m (142 ft) [10]
Width - 6.7 m (22 ft) [10]
Depth - 15.2 m (50 ft) [10]

EXCAVATED VOLUME DIMENSIONS:

Base of excavation is 43.3 m (142 ft) long by 6.7 m (22 ft) wide at a depth of 15.2 m (50 ft) [10]. See attached figure for excavation top dimensions.

Excavation Slopes - 1.5 H : 1.0 V

WASTE SITE LOCATION:

Northing: 151,590 [9]
Easting: 573,860 [9]

Reference Point: Center of trench [6]

ELEVATIONS:

Surface: 142.5 m (468 ft) [4]
Groundwater: 117.3 m (385 ft) [8]

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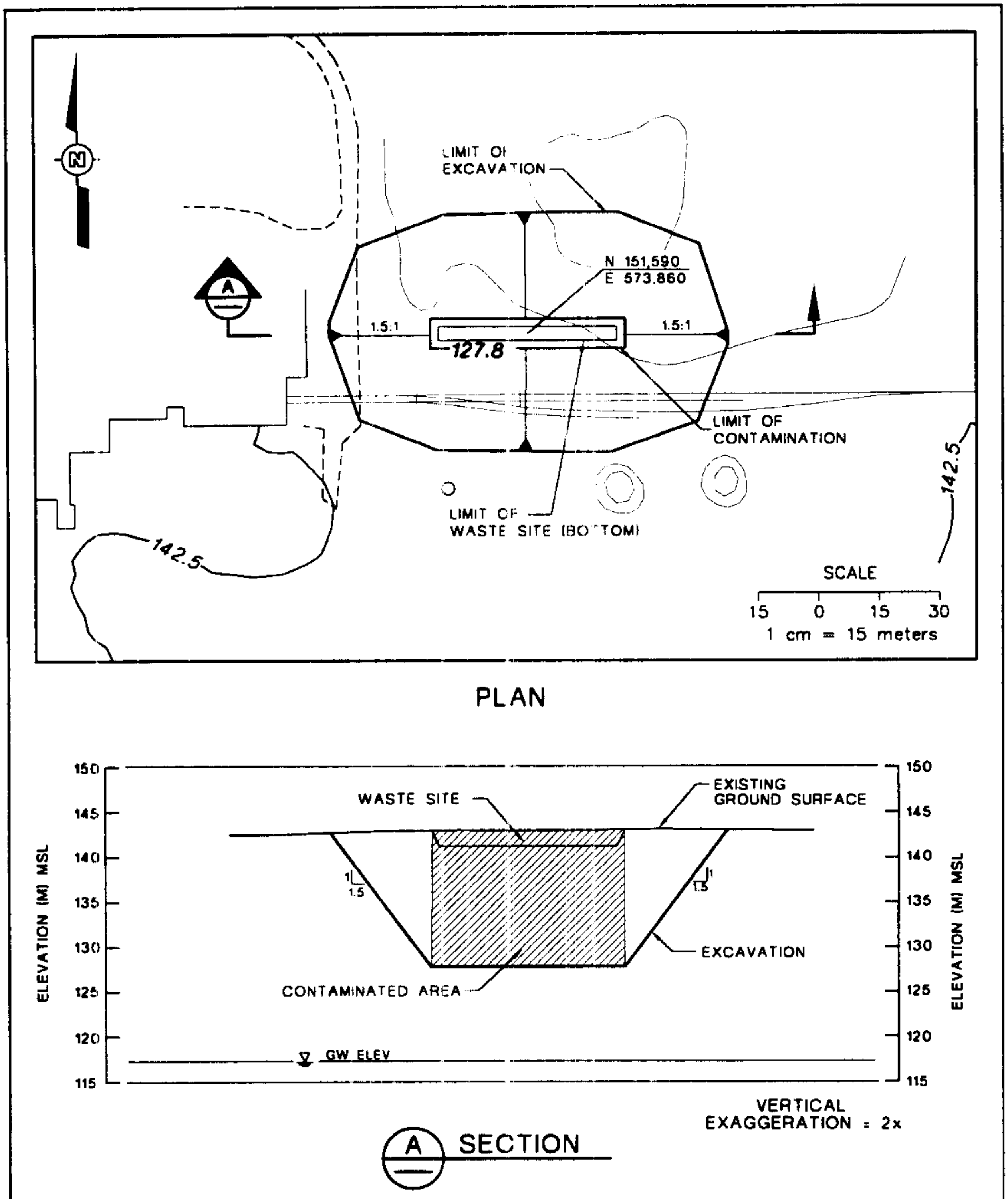
Figure GA1-1. IRM Site: 116-D-1A.



EXTENT OF CONTAMINATION

SURFACE AREA : 290 sq. meters
VOLUME : 4,409 cu. meters

EXTENT OF EXCAVATION

SURFACE AREA : 4,012 sq. meters
VOLUME : 28,937 cu. meters

116D1A

Volume Estimate
100-DR-1 Operable Unit

SITE NUMBER: 116-D-1B
SITE NAME: 105-D Storage Basin Trench No. 2

WASTE SITE DIMENSIONS:

Length - 30.5 m (100 ft) along the bottom 39.6 m (130 ft) at the surface [1]
Width - 3.1 m (10 ft) along the bottom, 12.2 m (40 ft) at the surface [1]
Depth - 4.6 m (15 ft) [1]
Slopes - 1.0 H : 1.0 V
Orientation - North-South lengthwise

Site was backfilled to 0.6 m (2 ft) above grade [2].

CONTAMINATED VOLUME DIMENSIONS:

Trench was filled to grade with liquids, side slopes, and substrate and are contaminated from surface to 6.1 m (20 ft) bls [10].

Length - 39.6 m (130 ft) [10]
Width - 12.2 m (40 ft) [10]
Depth - 6.1 m (20 ft) [10]

EXCAVATED VOLUME DIMENSIONS:

Base of excavation is 69.5 m (228 ft) long by 42.1 m (138 ft) wide at a depth of 6.7 m (20 ft) [10]. See attached figure for excavation top dimensions.

Excavation Slopes - 1.5 H : 1.0 V

WASTE SITE LOCATION:

Northing: 151,611 [9]
Easting: 573,848 [9]

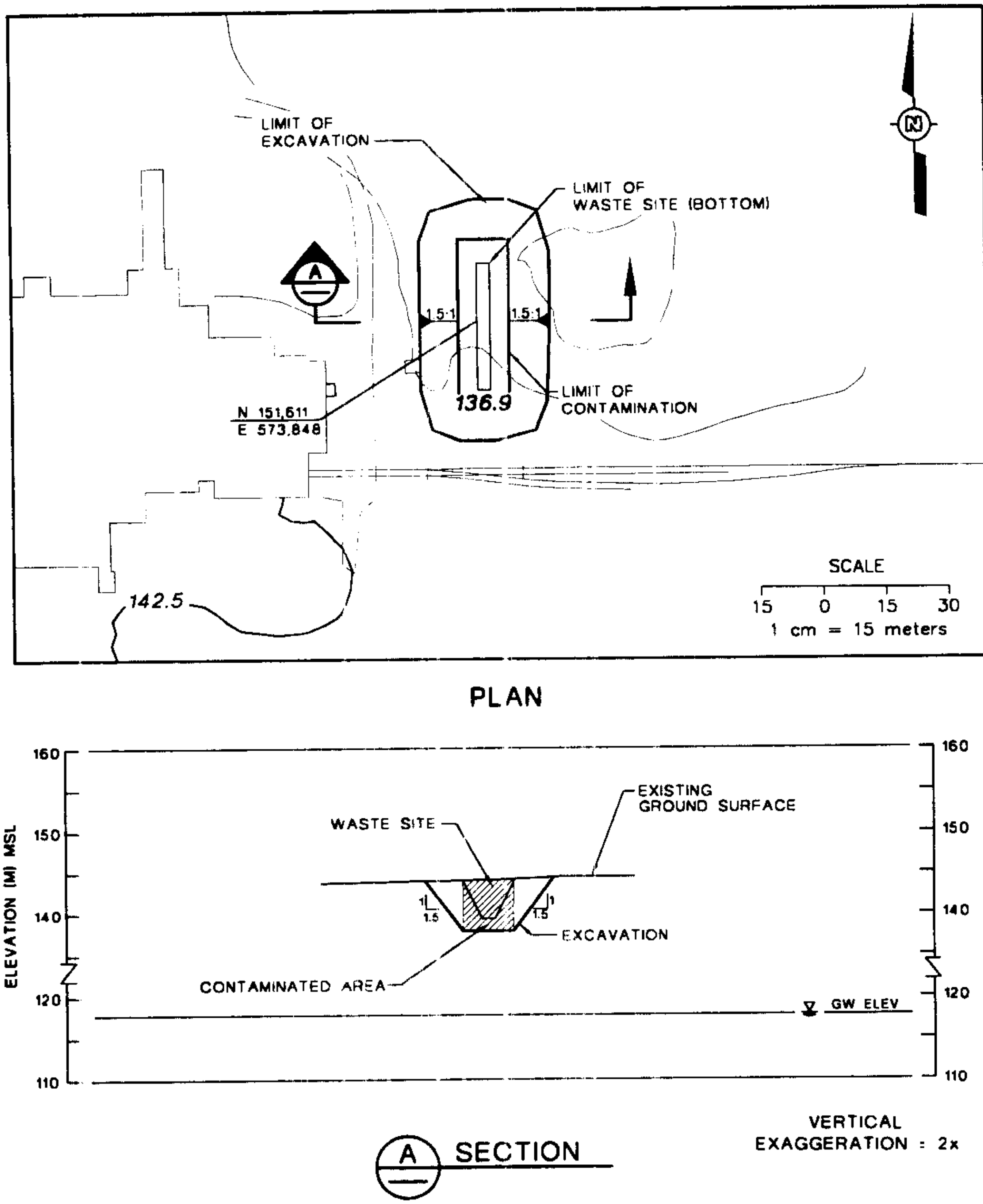
Reference Point: Center of west edge of bottom of unit [6].

ELEVATIONS:

Surface: 142.5 m (468 ft) [4]
Groundwater: 117.3 m (385 ft) [8]

DRAFT

Figure GA1-2. IRM Site: 116-D-1B.



EXTENT OF CONTAMINATION

SURFACE AREA : 483 sq. meters
VOLUME : 2,947 cu. meters

EXTENT OF EXCAVATION

SURFACE AREA : 1,703 sq. meters
VOLUME : 6,529 cu. meters

116D1B

Volume Estimate
100-DR-1 Operable Unit

SITE NUMBER: 116-D-2
SITE NAME: 105-D Pluto Crib

WASTE SITE DIMENSIONS:

Length - 3.1 m (10 ft) [1,2]
Width - 3.1 m (10 ft) [1,2]
Depth - 3.1 m (10 ft) [1,2]
Slopes - Vertical
Orientation - North-South [5]

The crib was set in ground with its upper surface at grade [2].

CONTAMINATED VOLUME DIMENSIONS:

Contamination begins at 3 m (10 ft) below surface and extends to 4.6 m (15 ft) below surface [10].

Length - 3.1 m (10 ft) [10]
Width - 3.1 m (10 ft) [10]
Depth - 1.5 m (5 ft); from 3.1 m (10 ft) to 4.6 m (15 ft) [10]

EXCAVATED VOLUME DIMENSIONS:

Bottom of excavation is 3.1 m (10 ft) by 3.1 m (10 ft) at a depth of 4.6 m (15 ft) [10]. See attached figure for excavation top dimensions.

Excavation Slopes - 1.5 H : 1.0 V

WASTE SITE LOCATION:

Northing: 151,510 [9]
Easting: 573,820 [9]

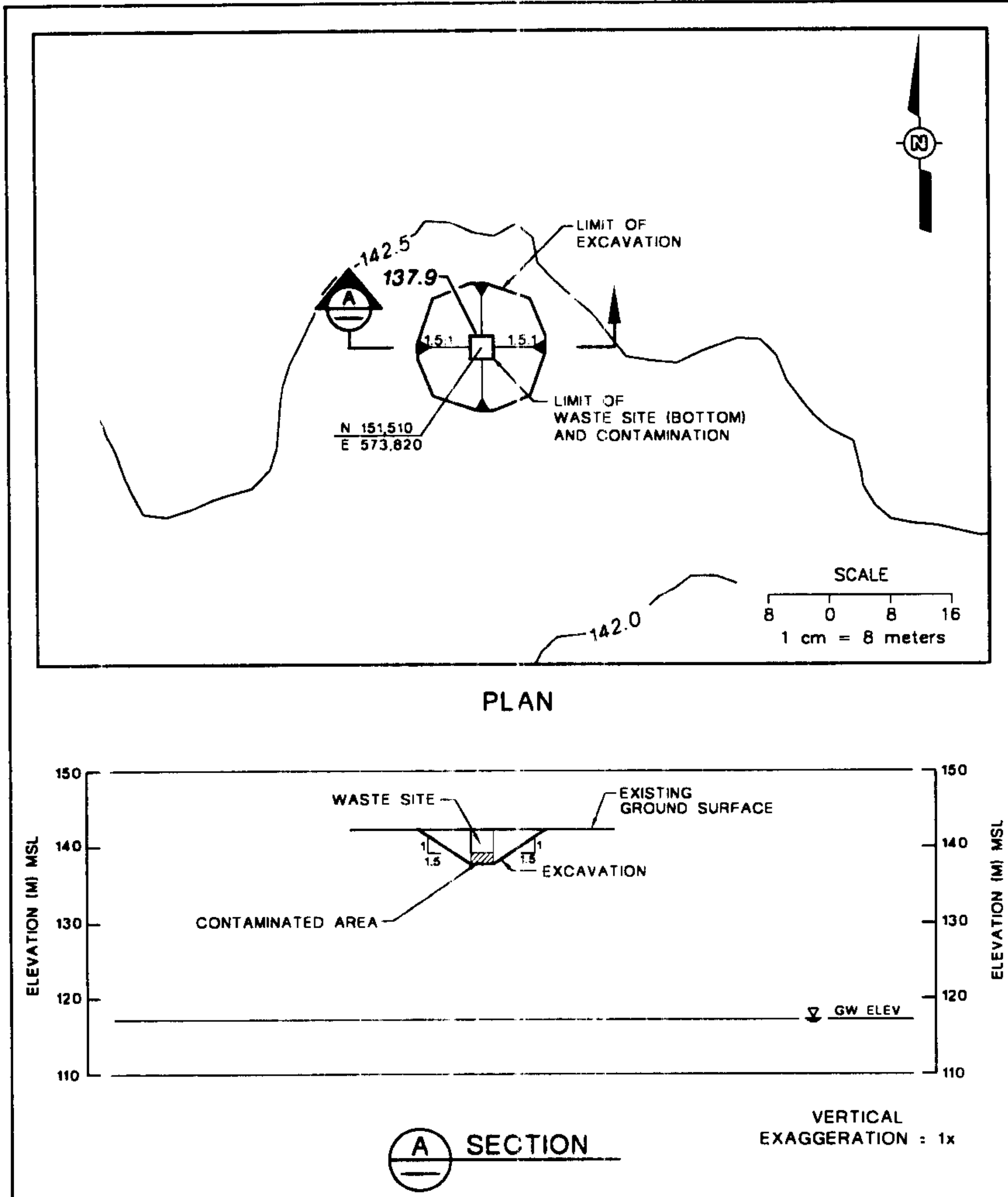
Reference Point: Center of crib [9].

ELEVATIONS:

Surface: 142.5 m (468 ft) [4]
Groundwater: 117.3 m (385 ft) [8]

DRAFT

Figure GA1-3. IRM Site 116-D-2.



EXTENT OF CONTAMINATION

SURFACE AREA : 9.6 sq. meters
VOLUME : 14.4 cu. meters

EXTENT OF EXCAVATION

SURFACE AREA : 224 sq. meters
VOLUME : 424 cu. meters

116D2A

Volume Estimate
100-DR-1 Operable Unit

SITE NUMBER: 116-D-7
SITE NAME: 107-D Retention Basin

WASTE SITE DIMENSIONS:

Length - 142.3 m (467 ft) [1,2,3]
Width - 70.1 m (230 ft) [1,2,3]
Depth - 7.3 m (24 ft) [1,2]
Slopes - Vertical
Orientation - East-West lengthwise [3]

Walls and baffles were demolished, site backfilled with 0.6 m (2 ft) of soil [1].

CONTAMINATED VOLUME DIMENSIONS:

Contamination extends 6.1 m (20 ft) to the north, 3.1 m (10 ft) to the south, east, and west [10].

Length - 148.4 m (487 ft) [10]
Width - 79.2 m (260 ft) [10]
Depth - 10.7 m (35 ft) [10]

EXCAVATED VOLUME DIMENSIONS:

Bottom of excavation is 148.4 m (487 ft) by 79.2 m (260 ft) at a depth of 10.7 m (35 ft) [10]. See attached figure for excavation top dimensions.

Excavation Slopes - 1.5 H : 1.0 V

WASTE SITE LOCATION:

Northing: 152,337 [9]
Easting: 573,624 [9]

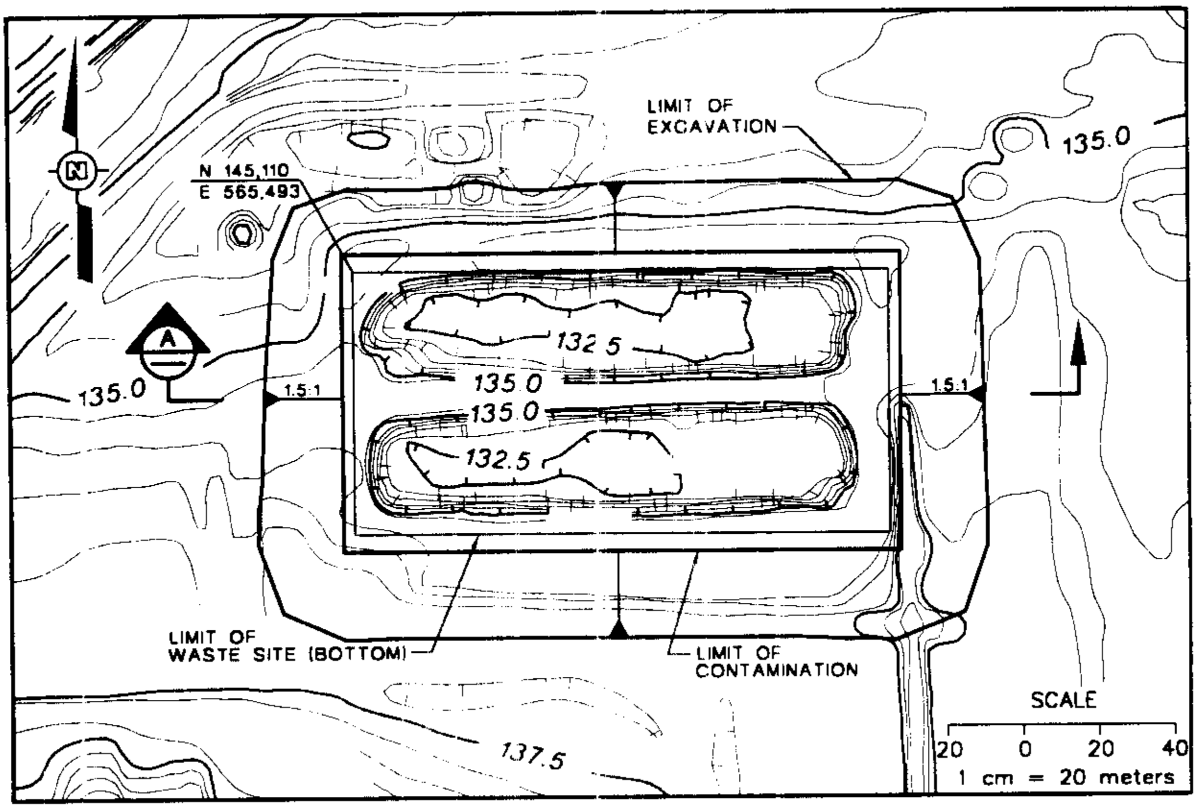
Reference Point: Northwest corner [9]

ELEVATIONS:

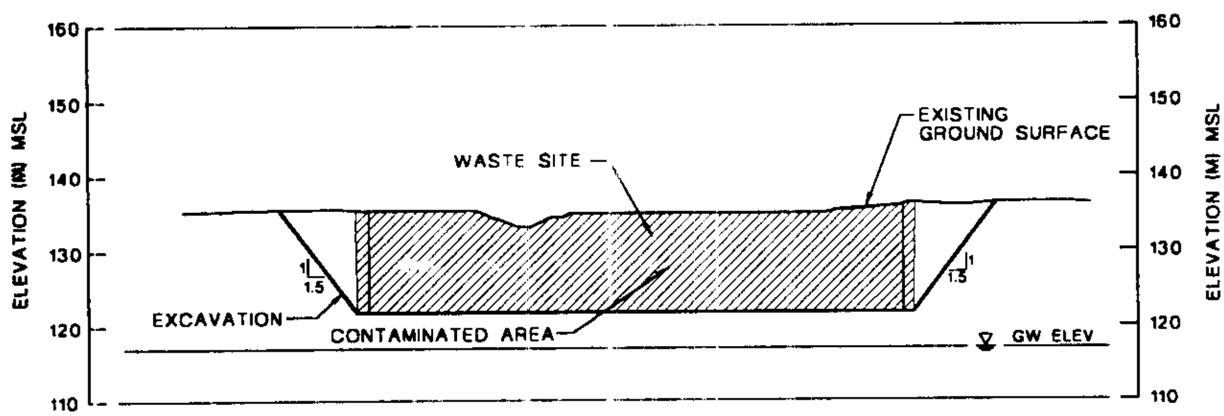
Surface: 132.5 m (435 ft) [4]
Groundwater: 116.9 m (384 ft) [8]

DRAFT

Figure GA1-4. IRM Site: 116-D-7.



PLAN



A SECTION

EXTENT OF CONTAMINATION

SURFACE AREA = 11,753 sq meters
VOLUME = 125,760 cu meters

EXTENT OF EXCAVATION

SURFACE AREA = 22,514 sq. meters
VOLUME = 217,989 cu. meters

116D7

Volume Estimate
100-DR-1 Operable Unit

SITE NUMBER: 116-DR-1 and 2
SITE NAME: 107-DR Liquid Waste Disposal Trench Nos. 1 and 2

WASTE SITE DIMENSIONS:

Length - Varies, see attached figure [3]
Width - Varies, see attached figure [3]
Depth - 6.1 m (20 ft) [1,2]
Slopes - 1.0 H : 1.0 V
Orientation - N/A

116-DR-1 and 116-DR-2 are assumed to have been enlarged to make one trench [2].

CONTAMINATED VOLUME DIMENSIONS:

Trench was filled to grade with liquids, side slopes, and substrate and are contaminated from 1.8 m (6 ft) to 7.6 m (25 ft) below surface [10].

Length - Varies, see attached figure [10]
Width - Varies, see attached figure [10]
Depth - 5.8 m (19 ft) from 1.8 m (6 ft) to 7.6 m (25 ft)

EXCAVATED VOLUME DIMENSIONS:

See attached figure for excavation top dimensions.

Excavation Slopes - 1.5 H : 1.0 V

WASTE SITE LOCATION:

Northing:	A.	152,341	B.	152,341	C.	152,338	D.	152,300	E.	152,270
Easting:		573,963		573,998		574,029		574,073		574,055
Northing:	F.	152,315	G.	152,315						
Easting:		574,027		573,963						

Reference Point: Point A is located at the northwest corner of the trench. The points proceed clockwise through Point G. All points indicate a trench bottom coordinate [9].

DRAFT

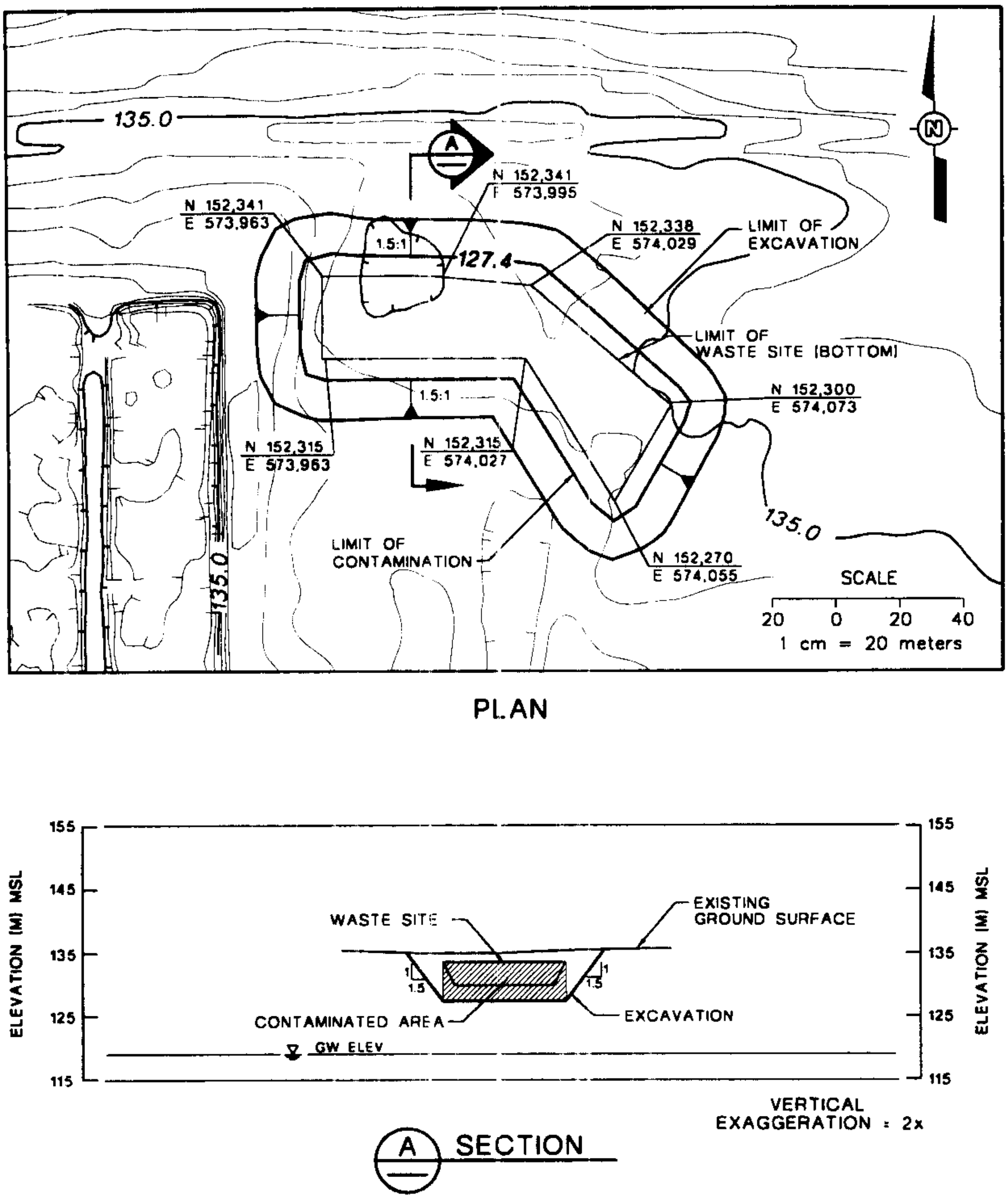
Volume Estimate
100-DR-1 Operable Unit

SITE NUMBER: 116-DR-1 and 2 (continued)
SITE NAME: 107-DR Liquid Waste Disposal Trench Nos. 1 and 2

ELEVATIONS:

Surface: 135.0 m (443 ft) [4]
Groundwater: 116.8 m (383 ft) [8]

Figure GA1-5. IRM Sites: 116-DR-1 and 116-DR-2.



EXTENT OF CONTAMINATION

SURFACE AREA = 4,215 sq. meters
VOLUME = 24,447 cu. meters

EXTENT OF EXCAVATION

SURFACE AREA = 9,717 sq. meters
VOLUME = 57,846 cu. meters

116DR1-2

DRAFT

Volume Estimate
100-DR-1 Operable Unit

SITE NUMBER: 116-D-9
SITE NAME: 117-D Seal Pit Crib

WASTE SITE DIMENSIONS:

Length - 3.1 m (10 ft) [1,2]
Width - 3.1 m (10 ft) [1,2]
Depth - 3.1 m (10 ft) [1,2]
Slopes - Vertical
Orientation - North-South [3]

A large steel vent cap is located in the center of the site [1].

CONTAMINATED VOLUME DIMENSIONS:

Assume no contaminated volume [10].

Length - N/A [10]
Width - N/A [10]
Depth - N/A [10]

EXCAVATED VOLUME DIMENSIONS:

N/A

Excavation Slopes - N/A

WASTE SITE LOCATION:

Northing: 151,536 [9]
Easting: 573,844 [9]

Reference Point: Center of crib [9]

ELEVATIONS:

Surface: 142.5 m (468 ft) [4]
Groundwater: 117.3 m (385 ft) [8]

Volume Estimate
100-DR-1 Operable Unit

SITE NUMBER: 116-DR-9
SITE NAME: 107-DR Retention Basin

WASTE SITE DIMENSIONS:

Length	- 182.9 m (600 ft) [1,2,3]
Width	- 83.2 m (273 ft) [1,2,3]
Depth	- 6.1 m (20 ft) [1.2]
Slopes	- Vertical
Orientation	- North-South lengthwise [3]

CONTAMINATED VOLUME DIMENSIONS:

Contamination extends 60 ft (18.3 m) to the south, 30 ft (9.1 m) to the north, east, and west [10].

Length	-	210.3 m (690 ft) [10]
Width	-	101.5 m (333 ft) [10]
Depth	-	12.2 m (40 ft) [10]

EXCAVATED VOLUME DIMENSIONS:

Bottom of excavation is 210.3 m (690 ft) by 101.5 m (333 ft) at a depth of 15.8 m (52 ft) [10]. See attached figure for excavation top dimensions.

Excavation Slopes - 1.5 H : 1.0 V

WASTE SITE LOCATION:

Northing: 152,336 [9]
Easting: 573,848 [9]

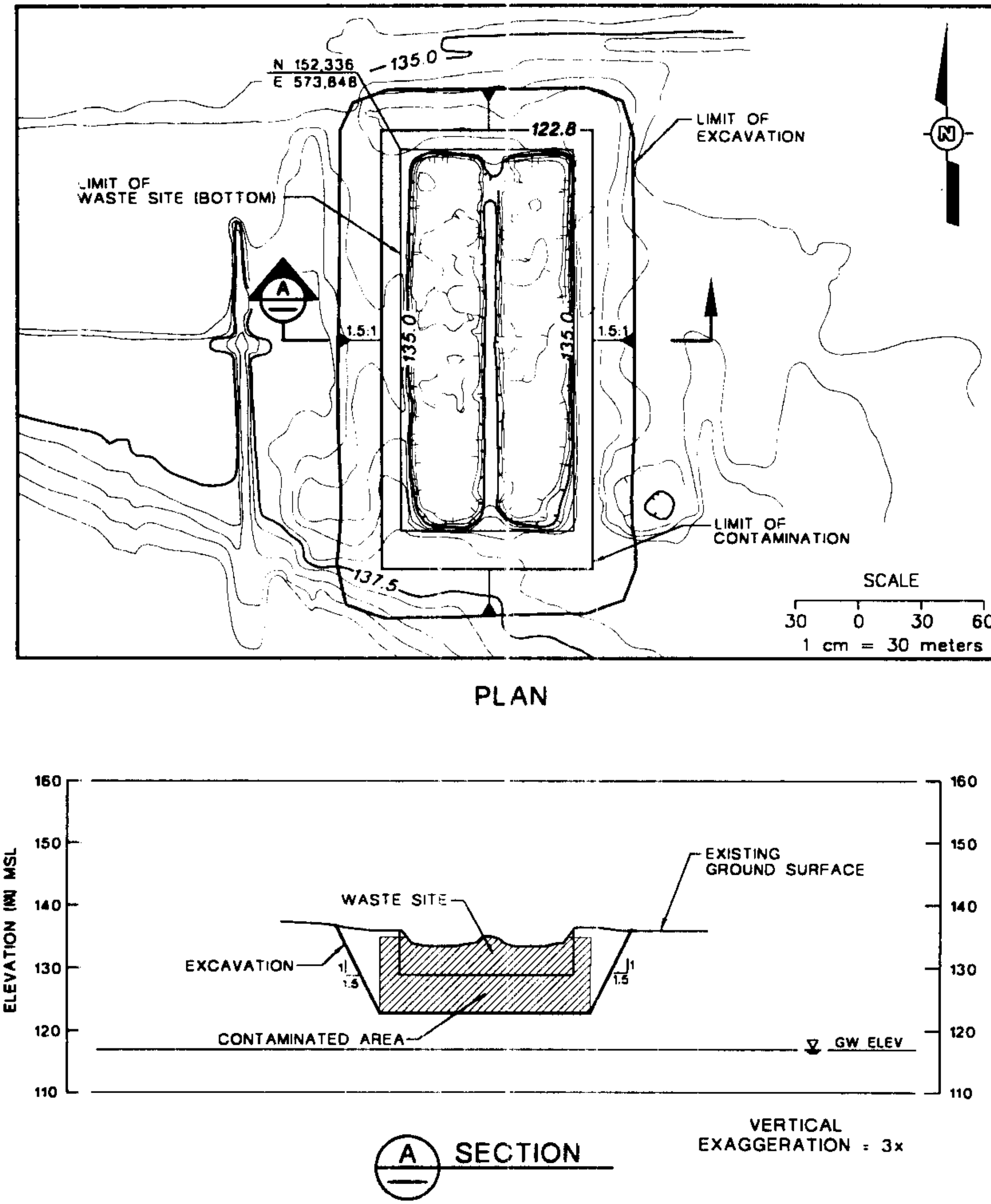
Reference Point: Northwest corner [9]

ELEVATIONS:

Surface: 135.0 m (443 ft) [4]
Groundwater: 116.9 m (384 ft) [8]

DRAFT

Figure GA1-6. IRM Site: 116-DR-9.



EXTENT OF CONTAMINATION

SURFACE AREA = 21,345 sq. meters
VOLUME = 260,414 cu meters

EXTENT OF EXCAVATION

SURFACE AREA = 35,285 sq. meters
VOLUME = 347,671 cu. meters

116DR9

Volume Estimate
100-DR-1 Operable Unit

SITE NUMBER: 132-D-1
SITE NAME: 115-D Demolished Gas Recirculation Building

WASTE SITE DIMENSIONS:

Length - 51.2 m (168 ft) [1]
Width - 29.9 m (98 ft) [1]
Depth - 3.4 m (11 ft) [1]
Slopes - Vertical
Orientation - North-South lengthwise [5]

The building was demolished in situ and buried 1 m (3 ft) below surface [1].

CONTAMINATED VOLUME DIMENSIONS:

Assume no contaminated volume [10].

Length - N/A [10]
Width - N/A [10]
Depth - N/A [10]

EXCAVATED VOLUME DIMENSIONS:

Excavation Slopes - N/A

WASTE SITE LOCATION:

Northing: 151,523 [9]
Easting: 573,785 [9]

Reference Point: Northwest corner [9]

ELEVATIONS:

Surface: 142.5 m (468 ft) [4]
Groundwater: 117.3 m (385 ft) [8]

DRAFT

Volume Estimate
100-DR-1 Operable Unit

SITE NUMBER: 132-D-2
SITE NAME: 117-D Filter Building

WASTE SITE DIMENSIONS:

Length - 18 m (59 ft) [1]
Width - 11.9 m (39 ft) [1]
Depth - 8.2 m (27 ft) [1]
Slopes - Vertical
Orientation - North-South lengthwise [3,5]

The site was demolished in situ and buried 1.0 m (3.0 ft) below surface [1].

CONTAMINATED VOLUME DIMENSIONS:

Assume no contaminated volume [10].

Length - N/A [10]
Width - N/A [10]
Depth - N/A [10]

EXCAVATED VOLUME DIMENSIONS:

Excavation Slopes - N/A

WASTE SITE LOCATION:

Northing: 151,521 [9]
Easting: 573,745 [9]

Reference Point: Northeast corner [9]

ELEVATIONS:

Surface: 142.5 m (468 ft) [4]
Groundwater: 117.3 m (385 ft) [8]

Volume Estimate
100-DR-1 Operable Unit

SITE NUMBER: 132-D-3
SITE NAME: Effluent Pumping Station

WASTE SITE DIMENSIONS:

Length - 6.1 m (20 ft) [1]
Width - 6.1 m (20 ft) [1]
Depth - 9.8 m (32 ft) [1]
Slopes - Vertical
Orientation - North-South

The site was demolished in situ, and covered with 1 m (3 ft) of backfill [1].

CONTAMINATED VOLUME DIMENSIONS:

Assume no contaminated volume [10].

Length - N/A [10]
Width - N/A [10]
Depth - N/A [10]

EXCAVATED VOLUME DIMENSIONS:

N/A

Excavation Slopes - N/A

WASTE SITE LOCATION:

Northing: 151,551 [9]
Easting: 573,776 [9]

Reference Point: Northeast corner [9]

ELEVATIONS:

Surface: 142.5 m (468 ft) [4]
Groundwater: 117.3 m (385 ft) [8]

DRAFT

Volume Estimate
100-DR-1 Operable Unit

SITE NUMBER:
SITE NAME: 107-D/107-D Sludge Disposal Trench No. 1

WASTE SITE DIMENSIONS:

Length - 32 m (105 ft) along the bottom, 38.1 m (125 ft) at top of trench [3]
Width - 9.1 m (30 ft) along the bottom, 15.2 m (50 ft) at top of trench [3]
Depth - 3.1 m (10 ft) [10]
Slopes - 1.0 H : 1.0 V
Orientation - North-South lengthwise [3]

Site was backfilled with 1.8 m (6 ft) of clean cover [10].

CONTAMINATED VOLUME DIMENSIONS:

Contamination begins at 1.8 m (6 ft) below surface and extends to 5.8 m (19 ft) below surface [10].

Length - 38.1 m (125 ft) [10]
Width - 15.2 m (50 ft) [10]
Depth - 4 m (13 ft) [10]

EXCAVATED VOLUME DIMENSIONS:

Bottom of excavation is 38.1 m (125 ft) by 15.2 m (50 ft) at a depth of 5.8 m (19 ft) [10]. See attached figure for excavation top dimensions.

Excavation Slopes - 1.5 H 1.0 V

WASTE SITE LOCATION:

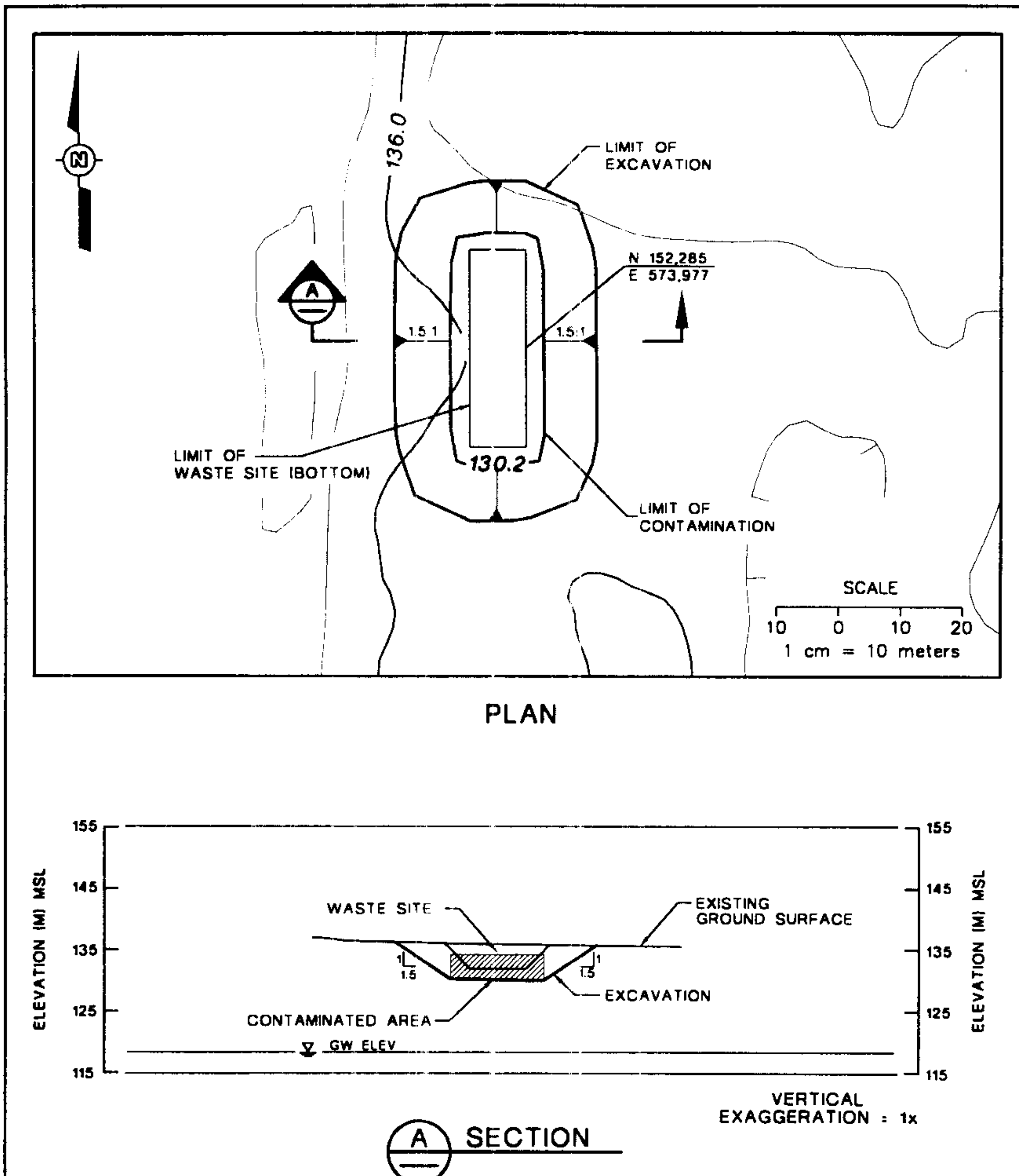
Northing: 152,285 [9]
Easting: 573,977 [9]

Reference Point: Center of east side of top of trench [9]

ELEVATIONS:

Surface: 135 m (443 ft) [4]
Groundwater: 116.8 m (383 ft) [8]

Figure GA1-7. IRM Site: 107-D/DR Sludge Disposal Trench No. 1.



EXTENT OF CONTAMINATION

SURFACE AREA : 652 sq. meters
VOLUME : 2,316 cu. meters

EXTENT OF EXCAVATION

SURFACE AREA : 1,635 sq. meters
VOLUME : 6,141 cu. meters

107D1

DRAFT

Volume Estimate
100-DR-1 Operable Unit

SITE NUMBER:
SITE NAME: 107-D/107-DR Sludge Trench No. 2

WASTE SITE DIMENSIONS:

Length - 32 m (105 ft) along the bottom, 38.1 m (125 ft) at top of trench [3]
Width - 9.1 m (30 ft) along the bottom, 15.2 m (50 ft) at top of trench [3]
Depth - 3.1 m (10 ft) [10]
Slopes - 1.0 H : 1.0 V
Orientation - North-South lengthwise [3]

Site was backfilled with 1.8 m (6 ft) of clean cover [10].

CONTAMINATED VOLUME DIMENSIONS:

Contamination begins at 1.8 m (6 ft) below surface and extends to 5.8 m (19 ft) below surface [10].

Length - 38.1 m (125 ft) [10]
Width - 15.2 m (50 ft) [10]
Depth - 4 m (13 ft) [10]

EXCAVATED VOLUME DIMENSIONS:

Bottom of excavation is 38.1 m (125 ft) by 15.2 m (50 ft) at a depth of 5.8 m (19 ft) [10].
See attached figure for excavation top dimensions.

Excavation Slopes - 1.5 H : 1.0 V

WASTE SITE LOCATION:

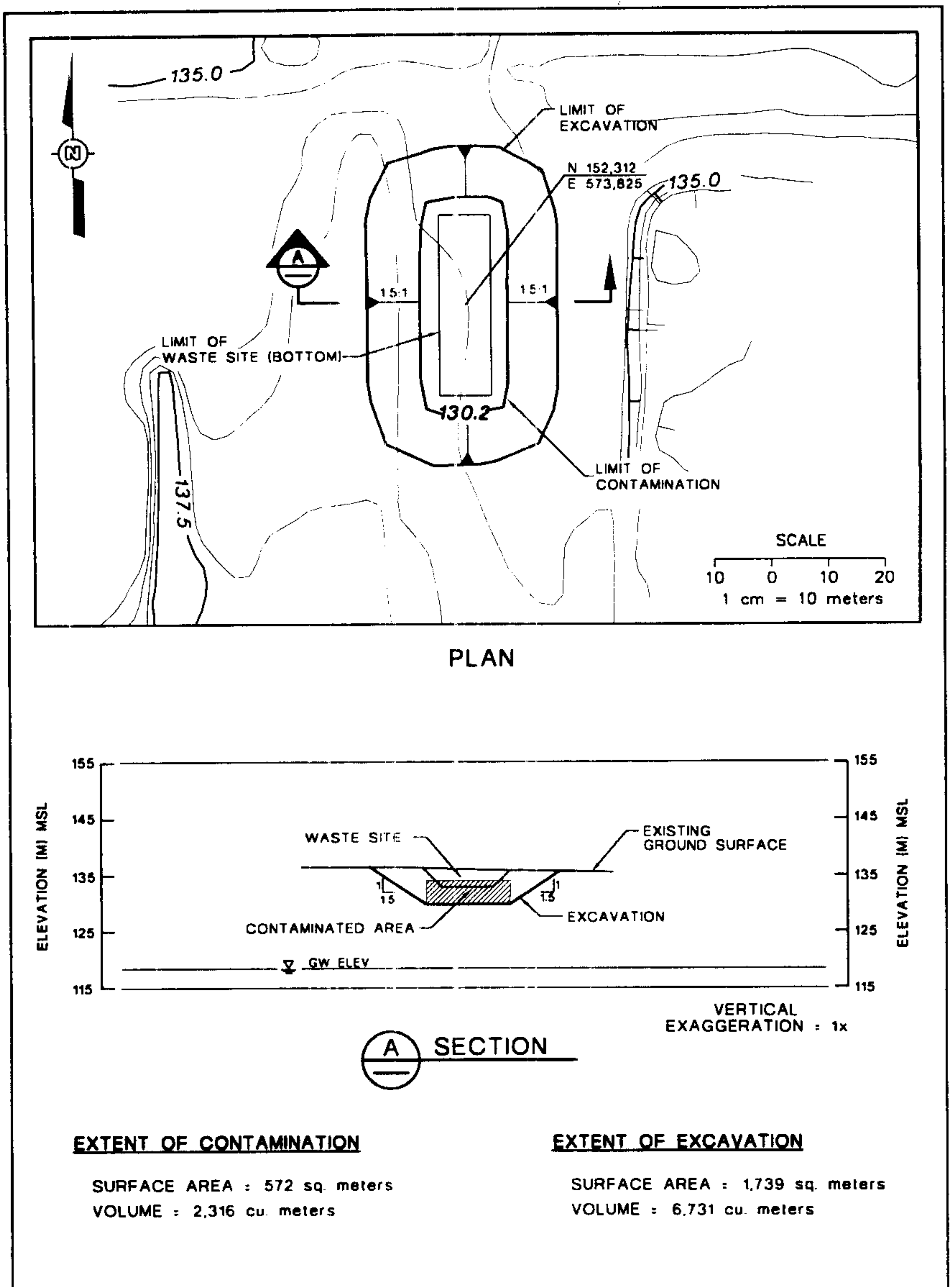
Northing: 152,312 [9]
Easting: 573,825 [9]

Reference Point: Center of trench [9]

ELEVATIONS:

Surface: 135 m (443 ft) [4]
Groundwater: 116.9 m (384 ft) [8]

Figure GA1-8. IRM Site: 107-D/DR Sludge Trench No. 2.



107D2

DRAFT

Volume Estimate
100-DR-1 Operable Unit

SITE NUMBER:
SITE NAME: 107-D/107-DR Sludge Trench No. 3

WASTE SITE DIMENSIONS:

Length - 32 m (105 ft) along the bottom, 38.1 m (125 ft) at top of trench [3]
Width - 9.1 m (30 ft) along the bottom, 15.2 m (50 ft) at top of trench [3]
Depth - 3.1 m (10 ft) [10]
Slopes - 1.0 H : 1.0 V
Orientation - East-West lengthwise [3]

Site was backfilled with 1.8 m (6 ft) of clean cover [10].

CONTAMINATED VOLUME DIMENSIONS:

Contamination begins at 1.8 m (6 ft) below surface and extends to 5.8 m (19 ft) below surface [10].

Length - 38.1 m (125 ft) [10]
Width - 15.2 m (50 ft) [10]
Depth - 4 m (13 ft) [10]

EXCAVATED VOLUME DIMENSIONS:

Bottom of excavation is 38.1 m (125 ft) x 15.2 m (50 ft) at a depth of 5.8 m (19 ft) [10].

Excavation Slopes - 1.5 H : 1.0 V

WASTE SITE LOCATION:

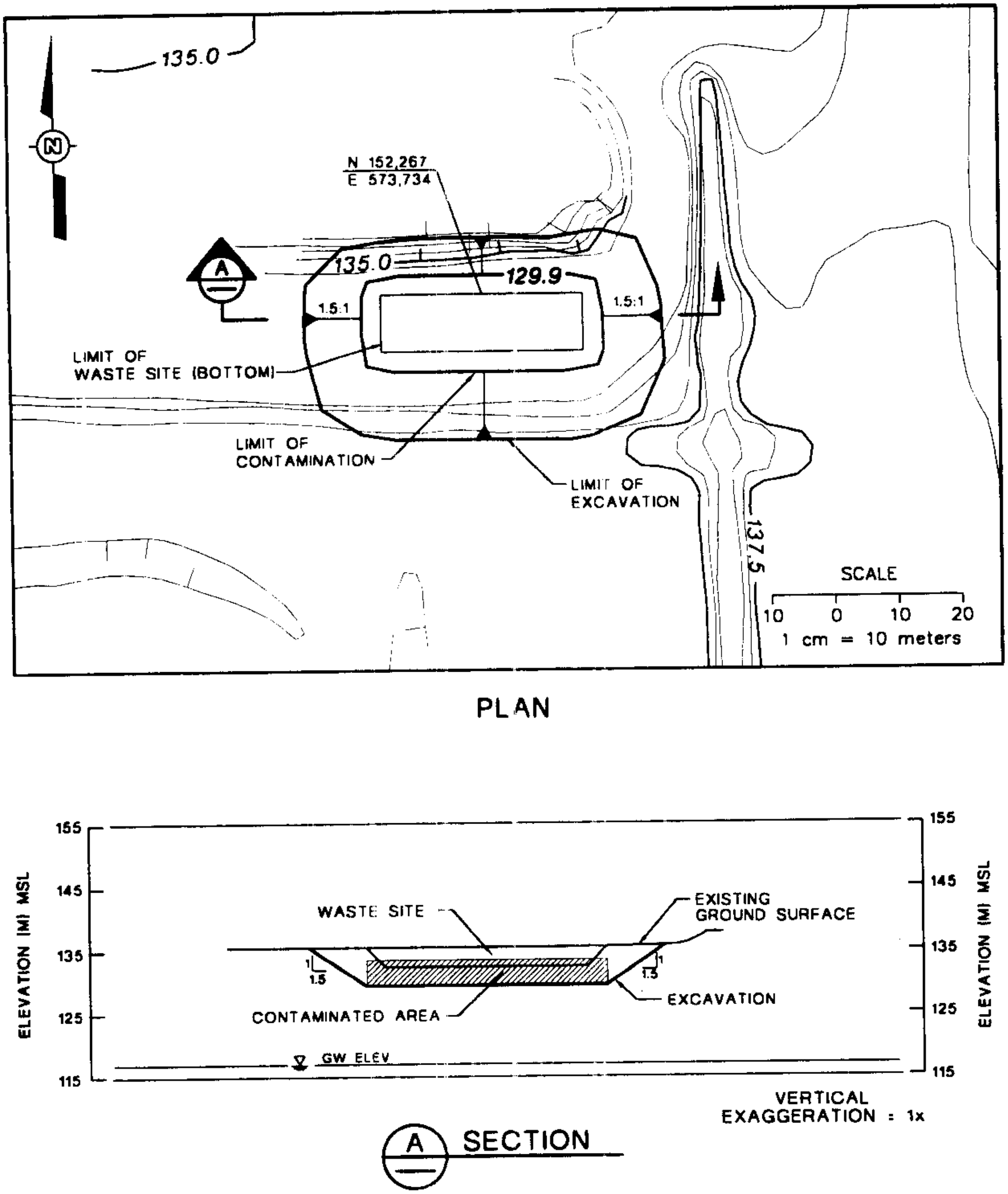
Northing: 152,267 [9]
Easting: 573,734 [9]

Reference Point: Center of north side of top of trench [9]

ELEVATIONS:

Surface: 135 m (443 ft) [4]
Groundwater: 117 m (384 ft) [8]

Figure GA1-9. IRM Site: 107-D/DR Sludge Trench No. 3.



EXTENT OF CONTAMINATION

SURFACE AREA = 579 sq. meters

VOLUME = 2,316 cu. meters

EXTENT OF EXCAVATION

SURFACE AREA = 1,675 sq. meters

VOLUME = 6,495 cu. meters

107D3

DRAFT

Volume Estimate
100-DR-1 Operable Unit

SITE NUMBER:
SITE NAME: 107-D/107-DR Sludge Trench No. 4

WASTE SITE DIMENSIONS:

Length	-	25.9 m (85 ft) along the bottom, 32 m (105 ft) at top of trench [3]
Width	-	6.1 m (20 ft) along the bottom, 12.2 m (40 ft) at top of trench [3]
Depth	-	3.1 m (10 ft) [10]
Slopes	-	1.0 H : 1.0 V
Orientation	-	East-West lengthwise [3]

Site was backfilled with 1.8 m (6 ft) of clean cover.

CONTAMINATED VOLUME DIMENSIONS:

Contamination begins at 1.8 m (6 ft) below surface and extends to 5.8 m (19 ft) below surface [10].

Length	-	32 m (105 ft) [10]
Width	-	12.2 m (40 ft) [10]
Depth	-	4 m (13 ft) [10]

EXCAVATED VOLUME DIMENSIONS:

Bottom of excavation is 32 m (105 ft) by 12.2 m (40 ft) at a depth of 5.8 m (19 ft) [10]. See attached figure for excavation top dimensions.

Excavation Slopes - 1.5 H : 1.0 V

WASTE SITE LOCATION:

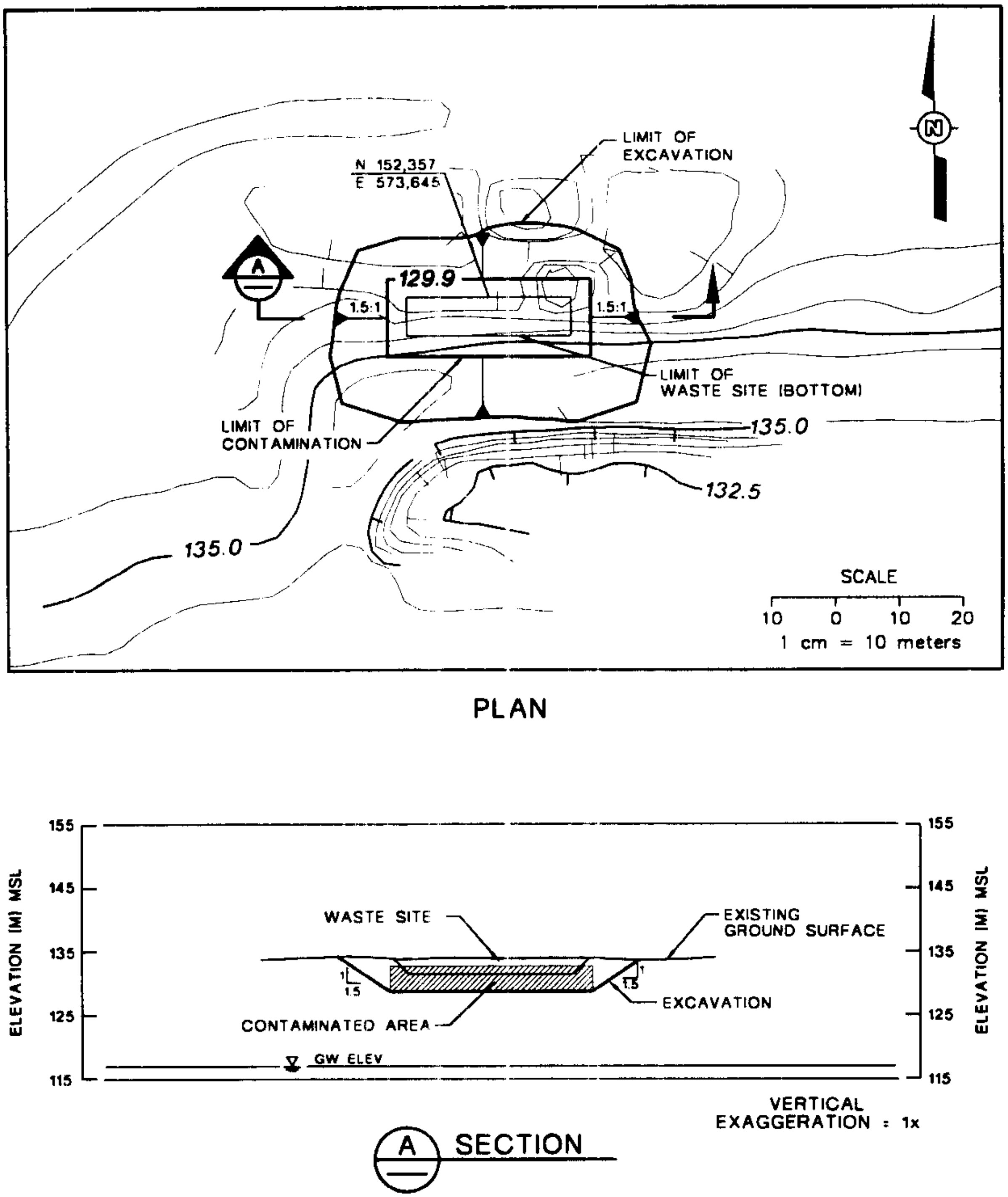
Northing: 152,357 [9]
Easting: 573,645 [9]

Reference Point: Center of north side of trench [9]

ELEVATIONS:

Surface: 135 m (443 ft) [4]
Groundwater: 116.9 m (384 ft) [8]

Figure GA1-10. IRM Site: 107-D/DR Sludge Trench No. 4.



EXTENT OF CONTAMINATION

SURFACE AREA = 390 sq. meters
VOLUME = 1,561 cu. meters

EXTENT OF EXCAVATION

SURFACE AREA = 1,338 sq. meters
VOLUME = 4,615 cu. meters

107D4

DRAFT

Volume Estimate
100-DR-1 Operable Unit

SITE NUMBER:
SITE NAME: 107-D/107-DR Sludge Trench No. 5

WASTE SITE DIMENSIONS:

Length	-	15.2 m (50 ft) along the bottom, 27.4 m (90 ft) at top of trench [3]
Width	-	6.1 m (20 ft) along the bottom, 18.3 m (60 ft) at top of trench [3]
Depth	-	3.1 m (10 ft) [10]
Slopes	-	1.0 H : 1.0 V
Orientation	-	East-West lengthwise [3]

Site was backfilled with 1.8 m (6 ft) of clean cover.

CONTAMINATED VOLUME DIMENSIONS:

Contamination begins at 1.8 m (6 ft) below surface and extends to 5.8 m (19 ft) below surface [10].

Length	-	27.4 m (90 ft) [10]
Width	-	18.3 m (60 ft) [10]
Depth	-	4 m (13 ft) [10]

EXCAVATED VOLUME DIMENSIONS:

Bottom of excavation is 27.4 m (90 ft) by 18.3 m (60 ft) at a depth of 5.8 m (19 ft) [10]. See attached figure for excavation top dimensions.

Excavation Slopes - 1.5 H : 1.0 V

WASTE SITE LOCATION:

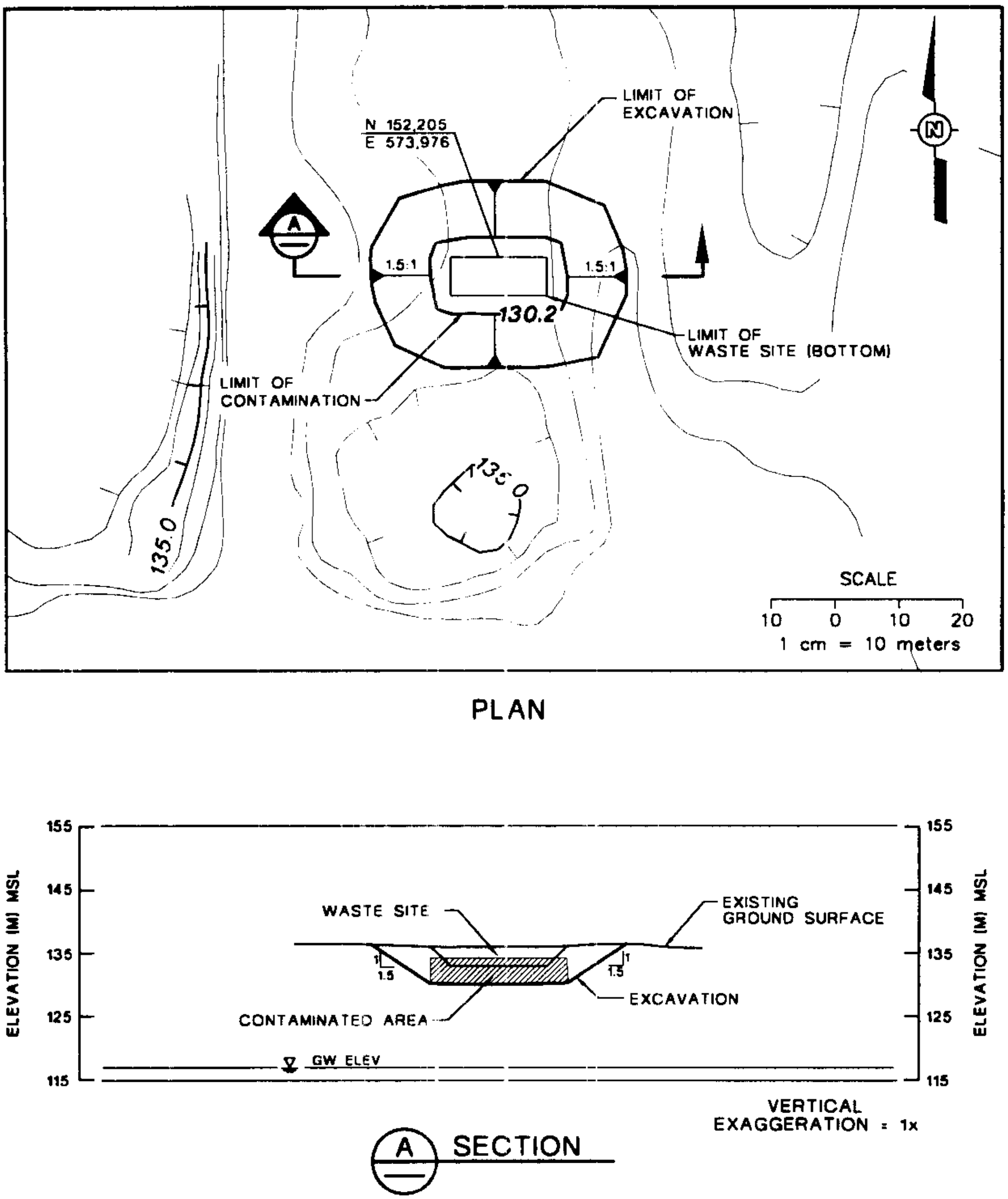
Northing: 152,205 [9]
Easting: 573,976 [9]

Reference Point: Center of north side of top of trench [8]

ELEVATIONS:

Surface: 136 m (446 ft) [4]
Groundwater: 116.8 m (383 ft) [7]

Figure GA1-11. IRM Site: 107-D/DR Sludge Trench No. 5.



EXTENT OF CONTAMINATION

SURFACE AREA = 501 sq. meters
VOLUME = 2,005 cu. meters

EXTENT OF EXCAVATION

SURFACE AREA = 1,018 sq. meters
VOLUME = 3,493 cu. meters

107D5

DRAFT

Volume Estimate
100-DR-1 Operable Unit

SITE NUMBER:
SITE NAME: 118-D4-A Burial Ground

WASTE SITE DIMENSIONS:

Length - 45.7 m (150 ft) along the bottom, 57.9 m (190 ft) at surface [3]
Width - 6.1 m (20 ft) along the bottom, 18.3 m (60 ft) at surface [3]
Depth - 6.1 m (20 ft) [assumed]
Slopes - 1.0 H : 1.0 V
Orientation - North-South lengthwise [3]

Assume backfilled with 1.5 m (5 ft) of clean cover [10].

CONTAMINATED VOLUME DIMENSIONS:

Contamination is volume of trench. Contamination begins at 1.5 m (5 ft) below surface and extends to 7.6 m (25 ft) below surface [10].

Length - 45.7 m (150 ft) along the bottom, 57.9 m (190 ft) at surface [10]
Width - 6.1 m (20 ft) along the bottom, 18.3 m (60 ft) at surface [10]
Depth - 6.1 m (20 ft) [10]

EXCAVATED VOLUME DIMENSIONS:

Bottom of excavation is 45.7 m (150 ft) x 6.1 m (20 ft) at a depth of 7.6 m (25 ft) [10]. See attached figure for excavation top dimensions.

Excavation Slopes - 1.5 H : 1.0 V

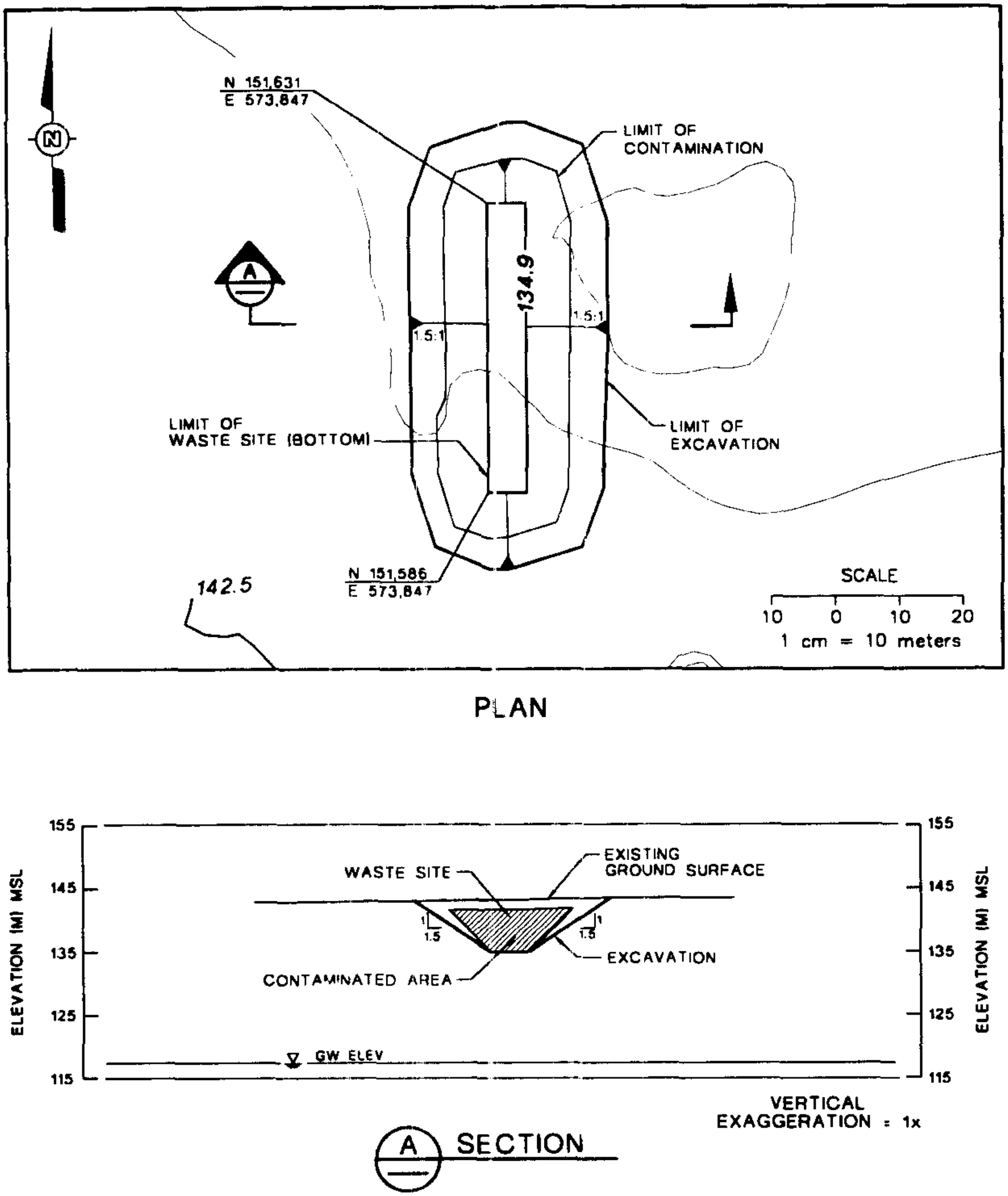
WASTE SITE LOCATION:

Northing: 151,586 [9]	Northing: 151,631 [9]
Easting: 573,847 [9]	Easting: 573,847 [9]
Reference Point: Southwest corner of surface [9]	Reference Point: Northwest corner of surface [9]

ELEVATIONS:

Surface: 142.5 m (468 ft) [4]
Groundwater: 117.3 m (385 ft) [8]

Figure GA1-12. IRM Site: 4A Burial Ground.



EXTENT OF CONTAMINATION

SURFACE AREA : 1,059 sq. meters
VOLUME : 4,564 cu. meters

EXTENT OF EXCAVATION

SURFACE AREA : 1,959 sq. meters
VOLUME : 8,656 cu. meters

4AG

DRAFT

Volume Estimate
100-DR-1 Operable Unit

SITE NUMBER:
SITE NAME: 118-D4-B Burial Ground

WASTE SITE DIMENSIONS:

Length - 24.7 m (81 ft) along the bottom, 32 m (105 ft) at surface [3]
Width - 7.3 m (24 ft) at the surface [3]
Depth - 3.7 m (12 ft) [10]
Slopes - 1.0 H : 1.0 V
Orientation - Long Axis Oriented S 38° W

Assume a 'V' trench with 3.7 m (24 ft) width at the surface. Site was backfilled with 1.5 m (5 ft) of clean cover [10].

CONTAMINATED VOLUME DIMENSIONS:

Contamination is volume of trench. Contamination begins at 1.5 m (5 ft) below surface and extends to 5.2 m (17 ft) below surface [10].

Length - 24.7 m (81 ft) along the bottom, 32 m (105 ft) at surface [10]
Width - 7.3 m (24 ft) at the surface [10]
Depth - 3.7 m (12 ft) [10]

EXCAVATED VOLUME DIMENSIONS:

Bottom of excavation is 24.7 m (81 ft) long at a depth of 5.2 m (17 ft) [10]. See attached figure for excavation top dimensions.

Excavation Slopes - 1.5 H : 1.0 V

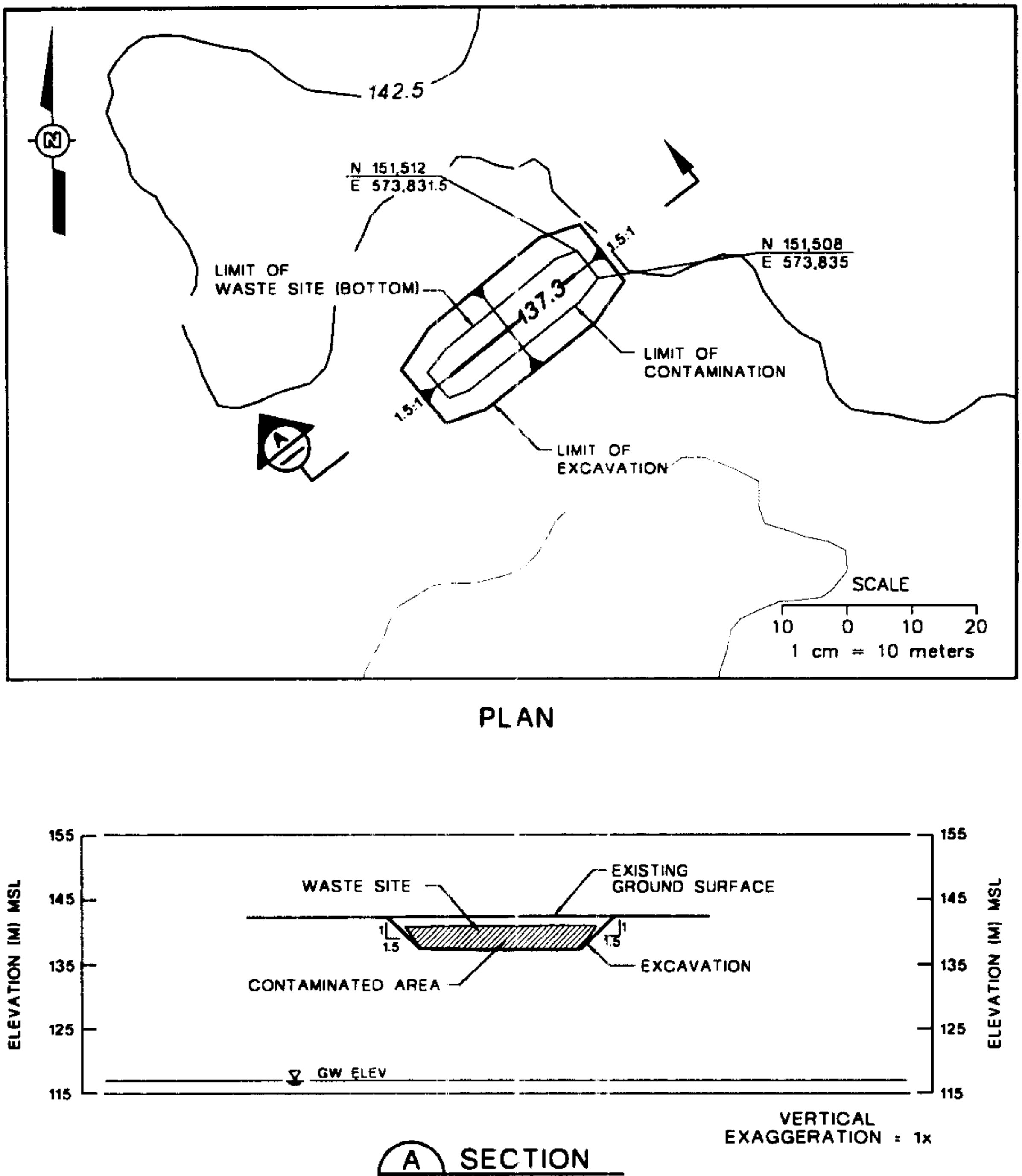
WASTE SITE LOCATION:

Northing:	151,512 [9]	Northing:	151,508 [9]
Easting:	573,831.5 [9]	Easting:	573,835 [9]
Reference Point:	Northwest corner at surface [9]	Reference Point:	Northeast corner at surface [9]

ELEVATIONS:

Surface: 142.5 m (468 ft) [4]
Groundwater: 117.3 m (385 ft) [8]

Figure GA1-13. IRM Site: 4B Burial Ground.



EXTENT OF CONTAMINATION

SURFACE AREA : 215 sq. meters
VOLUME : 350 cu. meters

EXTENT OF EXCAVATION

SURFACE AREA : 523 sq. meters
VOLUME : 1,206 cu. meters

4BG

Volume Estimate
100-DR-1 Operable Unit

SITE NUMBER:
SITE NAME: 118-18 Burial Ground

WASTE SITE DIMENSIONS:

Length - 12.2 m (40 ft) along the bottom, 24.4 m (80 ft) at the surface [3].
Width - 12.2 m (40 ft) at the surface [3]
Depth - 6.1 m (20 ft) [10]
Slopes - 1:0 H : 1.0 V
Orientation - North-South lengthwise [3]

Assume a 'V' trench with 12.2 m (40 ft) width at the surface. Site was backfilled with 1.5 m (5 ft) of clean cover [10].

CONTAMINATED VOLUME DIMENSIONS:

Contamination is volume of trench. Contamination begins at 1.5 m (5 ft) below surface and extends to 7.6 m (25 ft) below surface [10].

Length - 12.2 m (40 ft) along the bottom, 24.4 m (80 ft) at the surface [10]
Width - 12.2 m (40 ft) at the surface [10]
Depth - 6.1 m (20 ft) [10]

EXCAVATED VOLUME DIMENSIONS:

Bottom of excavation is 12.2 m (40 ft) long at a depth of 7.6 m (25 ft) [10]. See attached figure for excavation top dimensions.

Excavation Slopes - 1.5 H : 1.0 V

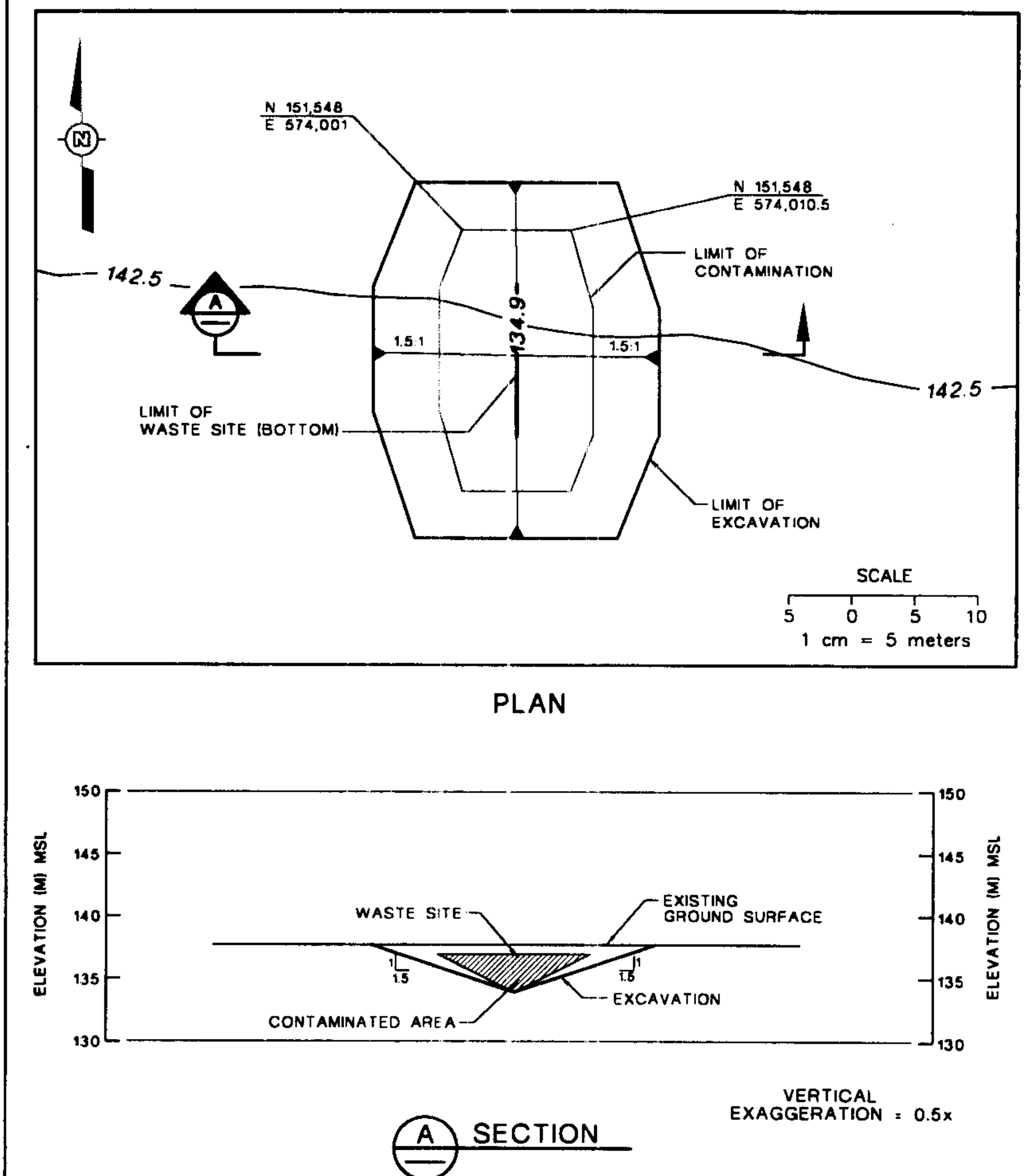
WASTE SITE LOCATION:

Northing:	151,548 [9]	Northing:	151,548 [9]
Easting:	574,001 [9]	Easting:	574,011.5 [9]
Reference Point:	Northwest corner at surface [9]	Reference Point:	Northeast corner at surface [9]

ELEVATIONS:

Surface: 142.5 m (468 ft) [4]
Groundwater: 117.3 m (385 ft) [7]

Figure GA1-14. IRM Site: 18 Burial Ground.



EXTENT OF CONTAMINATION

SURFACE AREA : 237 sq. meters
VOLUME : 625 cu. meters

EXTENT OF EXCAVATION

SURFACE AREA : 582 sq. meters
VOLUME : 1,826 cu. meters

18BG

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Volume Estimate
100-DR-1 Operable Unit

SITE NUMBER:
SITE NAME: 107-D & 107-DR Process Effluent Pipelines (soil and sludge)

WASTE SITE DIMENSIONS:

Length - 3,695.4 m (12,124 ft) [3]
Width - 1.5 m (5 ft) diameter [3]
Depth - Varies [11]
Slopes - Varies
Orientation - Varies

Length - 325.5 m (1,068 ft) [3]
Width - 1.07 m (42 in.) [3]
Depth - Varies [11]
Slopes - Varies
Orientation - Varies

Reinforced concrete box 2.06 m (6 ft x 9 in.) x 2.06 m (6 ft x 9 in.) x 9.1 m (30 ft) long.

CONTAMINATED VOLUME DIMENSIONS:

Soil around pipe. No contamination along length of pipe.

Sludge inside pipe. All pipes have contaminated sludge along bottom. Volume of sludge is insignificant, the volume calculated will be that of pipe void.

EXCAVATED VOLUME DIMENSIONS:

Depends on depth of pipe. Base of excavation is 0.61 m (2 ft) on each side of the pipe and begins 7.6 cm (3 in.) below invert of pipe.

Excavation Slopes - 1.5 H : 1.0 V

WASTE SITE LOCATION:

See figure.

ELEVATIONS:

See figure.

Figure GA1-15. IRM Site: 100-D/DR Pipelines.

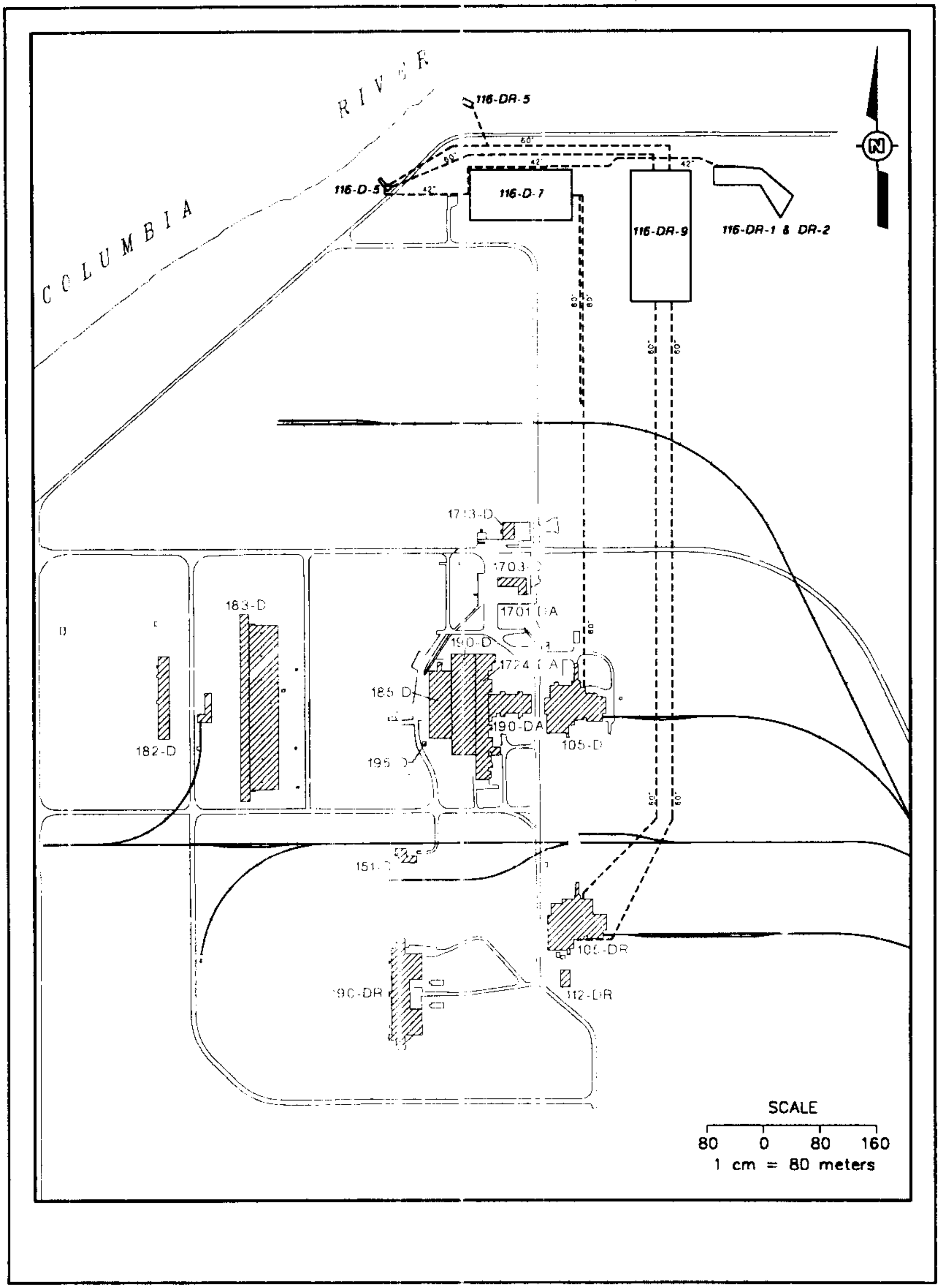

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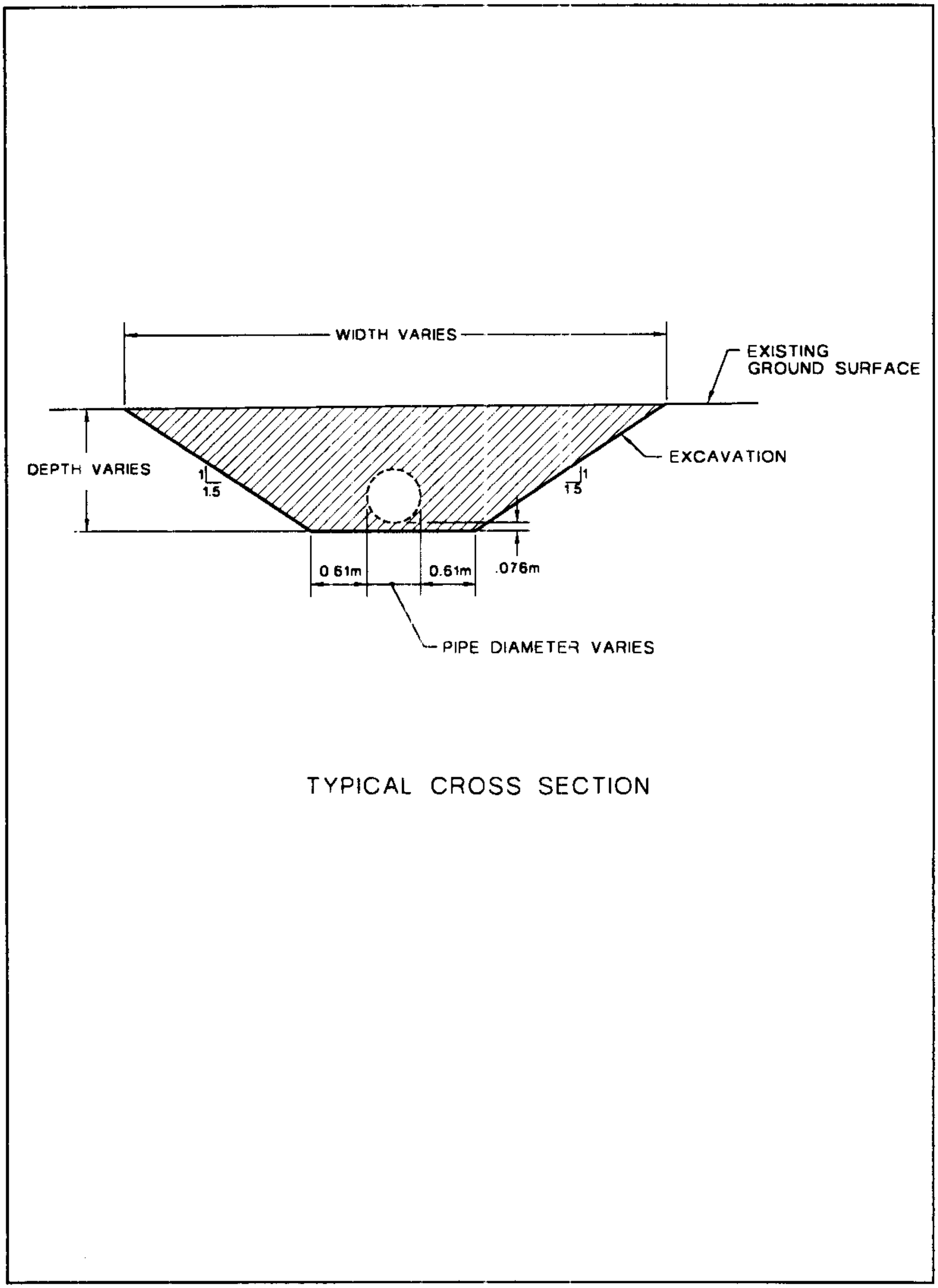
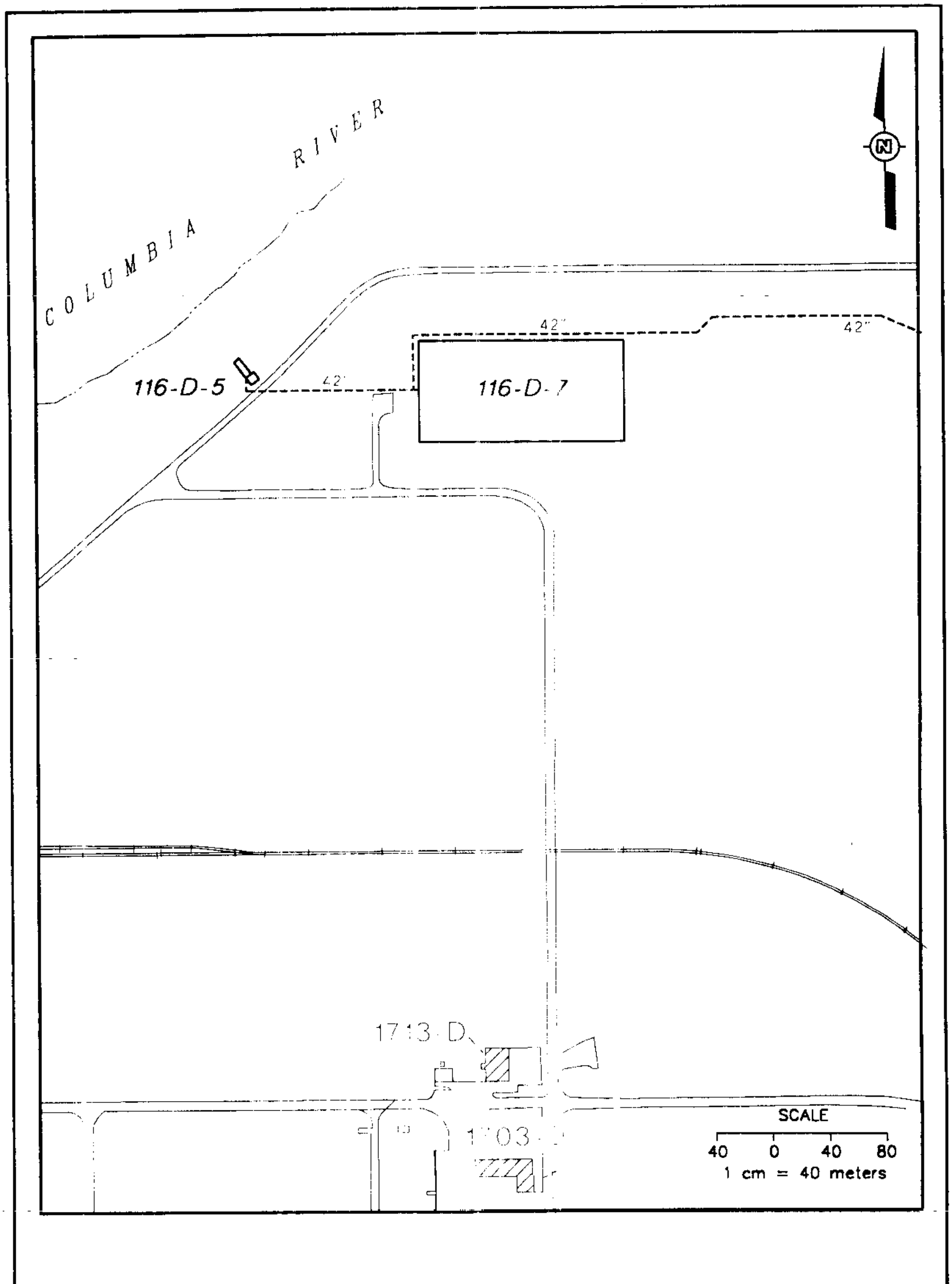
Figure GA1-16. Typical Pipeline Excavation Cross Section.



PEXSEC

Figure GA1-17. 100-D/DR 42-in. Pipelines.



PLN42D

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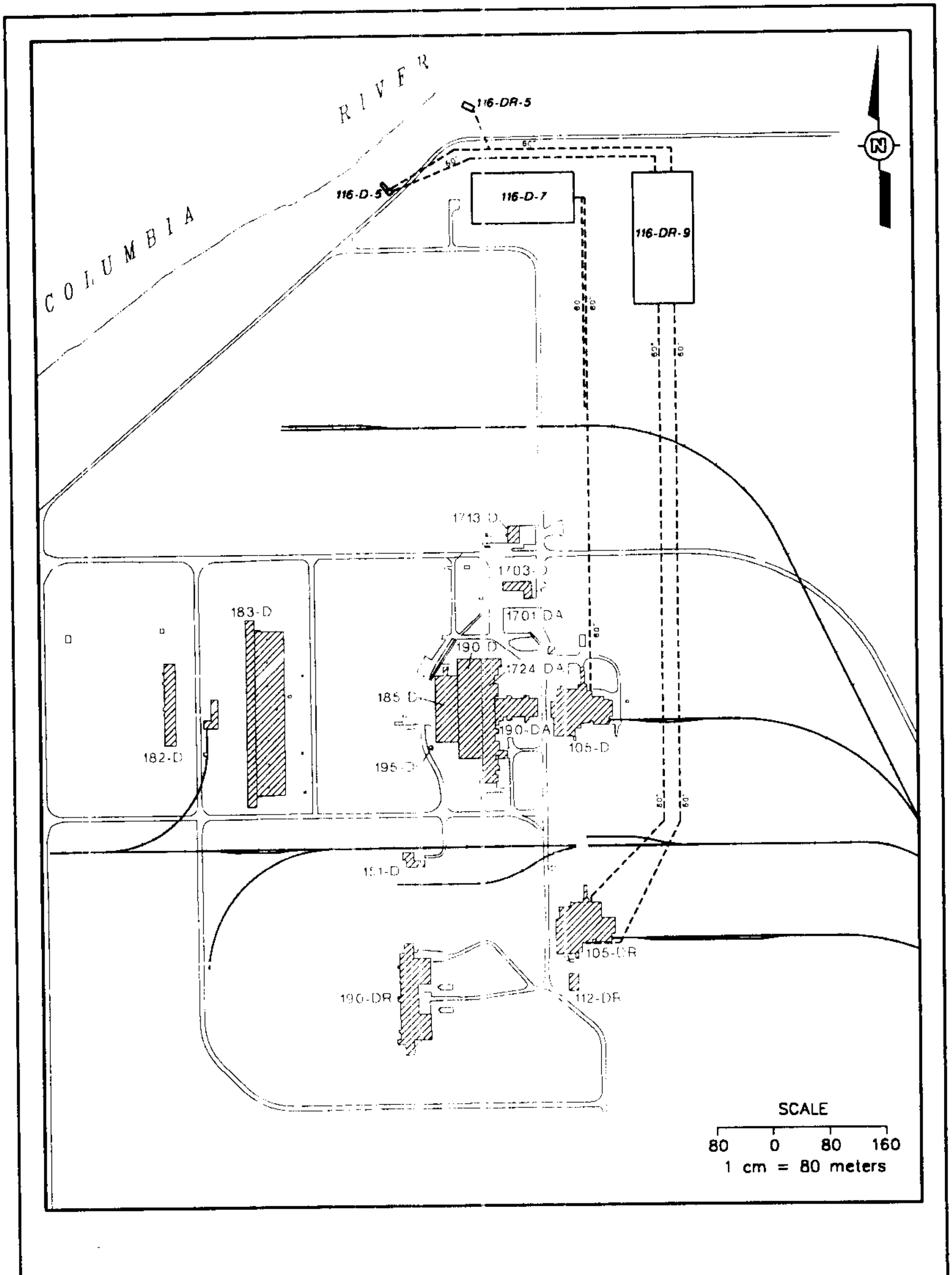
Figure GA1-18. 100-D/DR 60-in. Pipelines.



PLN60D

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ATTACHMENT 2

100-DR-1 OPERABLE UNIT WASTE SITE COST ESTIMATES

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1.0 COST ESTIMATE SUMMARIES

This appendix describes the cost models developed to support the source operable unit FFS reports. This appendix also documents the cost estimates developed for each waste site using the cost models.

1.1 DESCRIPTION OF COST MODELS

A cost model defines the Remedial Alternative activities and provides a method in which to estimate the associated cost. Each cost model is developed using the MCACES[1] software package.

The FFS cost models are based on the Environmental Restoration cost models used to develop the fiscal year planning baselines. The Environmental Restoration cost models were modified for the source operable unit focused feasibility studies to include all costs associated with the Remedial Alternatives. Project Time and Cost, Inc., supported both the baseline and FFS cost estimating activities. The fourteen cost models associated with the source operable unit focused feasibility studies are presented in the *100 Area Source Operable Unit Focused Feasibility Study Cost Models* (WHC 1994).

All cost models were developed based on a common work breakdown structure. There are three main elements within the structure; Offsite Analytical Services (ANA), Fixed Price Contractor (SUB), and Westinghouse Hanford Company (WHC).[2] Each element is defined further by additional levels. Table GA2-1 describes each element and level of a cost model. The work breakdown structure discussion is applicable for each cost model.

1.2 WASTE SITE COST ESTIMATES

Cost estimates were developed for each waste site addressed by the FFS based on the applicable cost model. The present worth for each estimate is based on a 5% discount rate and a disposal fee of $70/cubic yard. Because of current uncertainty as to the actual disposal fee, a Sensitivity Analysis is presented based on $700/cubic yard and $7,000/cubic yard besides $70/cubic yard. A matrix of the waste site, cost estimate table, and cost comparison figure is presented on Table GA2-2.

[1]MCACES: Micro Computer Aided Cost Estimating System
[2]The cost model terminology has not been updated to reflect the current change in the environmental restoration primary contractor.

Table GA2-1. Cost Model Work Breakdown Structure Discussion. (page 1 of 4)

ELEMENTS AND LEVELS	DESCRIPTION
ANA: Offsite Analytical Services	This element represents the offsite contractor performing laboratory analysis of samples.
ANA:02 Lab Analysis	This level includes the laboratory analysis of samples. 10% of routine samples and all quality control samples were assumed to be analyzed using level III and level V analysis. Site certification samples were assumed to be analyzed using level IV and V analysis.
SUB: Fixed Price Contractor	This element represents the remedial activities performed by the fixed price contractor.
SUB:01 Mobilization & Preparatory	This level includes mobilization of personnel and equipment, preparation for temporary facilities, and construction of temporary facilities.
SUB:02 Sample Collection and Monitoring	This level includes in situ monitoring and field sample collections. Assumptions for sampling include one regular sample per 32 yd^3 removed (one per container) and one quality control sample per twenty regular samples. Site certification samples were assumed to be taken at one per 2,500 ft^2 of bottom area with a minimum of four samples. Additional activities included treatment process sampling, which was assumed to be at a rate of one sample per 1,000 yd^3 of feed material.

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Table GA2-1. Cost Model Work Breakdown Structure Discussion. (page 2 of 4)

ELEMENTS AND LEVELS	DESCRIPTION
SUB:08 Solids Collection & Containment	This level includes excavation, capping, dynamic compaction, and personnel training. The excavation activity includes excavation of noncontaminated soil, excavation of contaminated soil, and demolition of solid waste materials. The capping activity includes all steps necessary to construct the appropriate cap layers. The dynamic compaction activity includes the physical compaction and dust suppression. Personnel training included the standard 40-hour course, a fundamentals of radiation safety course, and an 8-hour supervisor course.
SUB:13 Physical Treatment	This level includes both soil washing and solid waste compaction activities, such as mobilization/setup, personnel training, operation, system maintenance, demobilization, and pre and posttreatment plan submittals. Assumptions include a swell factor of 25% for the material being hauled from the excavation. 90% of the contaminated material was assumed to be compactible.
SUB:14 Thermal Treatment	This level includes thermal desorption mobilization/setup, personnel training, system operation, demobilization, and pre and posttreatment plan submittals. It is assumed that 5% of contaminated soil is organically contaminated and will be thermally treated should organics be present. An additional assumption includes a swell factor of 25% for the material being hauled from the excavation.
SUB:15 Stabilization/Fixation	This level includes In Situ Vitrification mobilization/setup, personnel training, system operation, demobilization, and pre and postconstruction submittals.

Table GA2-1. Cost Model Work Breakdown Structure Discussion. (page 3 of 4)

ELEMENTS AND LEVELS	DESCRIPTION
SUB:18 Disposal (Other than Commercial)	This level includes transport to the disposal facility and disposal fees/taxes. Assumptions include a 60% swell factor for demolition waste and a 25% swell factor for soils. Reduction in final volume is achieved and quantified based on specific treatment process. A disposal fee of $70/cubic yard was assumed based on current estimates for initial construction, operations/maintenance, and anticipated expansion of the environmental restoration disposal facility.
SUB:20 Site Restoration	This level includes activities such as load/haul borrow materials, spread/compact borrow and stockpiled materials, revegetation, and irrigation. Assumptions include the availability of onsite borrow materials at no additional charge.
SUB:21 Demobilization	This level includes the demobilization of temporary facilities. Note: Because multiple sites will be cleaned up within an operable unit and a cost for mobilization between sites is already included, no allowance for demobilization is made. Only the cost for removal of temporary utilities, fencing, and decontamination facilities are included.
ERC: Environmental Restoration Contractor	This element represents activities performed by the prime contractor.
ERC:02 Onsite Lab	This level includes mobile laboratory support, quality assurance/safety oversight, and health physics support. 90% of routine soil and solid waste samples were assumed to be analyzed using level III analysis. Routine sampling was assumed to occur at one sample per every 32 yd^3 removed (one per container.)
ERC:08 Solids Collection & Containment	This level includes personnel protection services including equipment, maintenance, and laundry services.

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Table GA2-1. Cost Model Work Breakdown Structure Discussion. (page 4 of 4)

ELEMENTS AND LEVELS	DESCRIPTION
Subcontractor Material Procurement Rate	The materials procurement rate reflects the activities associated with procurement or direct materials, inventories, and subcontracts.
Project Management/Construction Management	This cost accounts for project management, construction management, and office support personnel.
General & Administrative/Common Support Pool	The general and administrative costs consist of indirect costs of activities that benefit the company and cannot be identified to a specific end-cost objective. The common support pool provides for site-wide services of which the company pays a proportional share.
Contingency	A contingency value is calculated for the various waste site groups based on an evaluation of the various levels, the relative importance of the factor to successful completion of the action, and the probability that the factor will change.
Total, Capital, Annual Operations and Maintenance	The total represents the costs associated with the remedial action. The total cost includes capital and operations and maintenance of a cap. These costs are accounted for through the year 2018.
Present Worth	Present worth is calculated using a 5% discount rate over the life of the activity.

Table GA2-2. Waste Site Cost Presentation Matrix.

Waste Site	Cost Summary Table	Cost Comparison Figure
116-D-7	Table GA2-3	Figure GA1-1
116-DR-9	Table GA2-4	Figure GA1-2
116-DR-1/2	Table GA2-5	Figure GA1-3
107-D/DR #1	Table GA2-6	Figure GA1-4
107-D/DR #2	Table GA2-7	Figure GA1-5
107-D/DR #3	Table GA2-8	Figure GA1-6
107-D/DR #4	Table GA2-9	Figure GA1-7
107-D/DR #5	Table GA2-10	Figure GA1-8
116-D-1A	Table GA2-11	Figure GA1-9
116-D-1B	Table GA2-12	Figure GA1-10
116-D-2A	Table GA2-13	Figure GA1-11
Effluent Pipelines	Table GA2-14	Figure GA1-12
118-D-4A	Table GA2-15	Figure GA1-13
118-D-4B	Table GA2-16	Figure GA1-14
118-D-18	Table GA2-17	Figure GA1-15

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Table GA2-3. Cost Summary for 116-D-7 Retention Basin.

Cost Element		SS-4	SS-10
ANA: Offsite Analytical Services			
ANA:02	Monitoring, Sampling & Analysis	614,660	1,587,170
SUB: Fixed Price Contractor			
SUB:01	Mobilization & Preparatory	89,570	78,050
SUB:02	Monitoring, Sampling & Analysis	407,140	985,630
SUB:08	Solids Collection & Containment	2,452,840	3,525,920
SUB:13	Physical Treatment	-	12,757,810
SUB:14	Thermal Treatment	-	-
SUB:15	Stabilization/Fixation	-	-
SUB:18	Disposal (Other than Commercial)	32,736,010	23,182,110
SUB:20	Site Restoration	3,953,090	3,728,450
SUB:21	Demobilization	18,740	16,470
ERC: Environmental Restoration Contractor			
ERC:02	Monitoring, Sampling & Analysis	923,060	1,962,000
ERC:08	Solids Collection & Containment	97,430	204,700
Subcontractor Materials Procurement Rate		396,570	442,740
Project Management/Construction Management		6,161,170	7,032,580
General & Administration/Common Support Pool		12,045,090	13,748,700
Contingency		21,562,330	25,623,370
Total		81,457,710	94,875,700
Capital		81,457,710	82,273,340
Annual Operations & Maintenance		0	6,001,124
Present Worth		76,818,633	87,688,233

SS-3/SW-3: Containment
SS-4/SW-4: Removal/Disposal
SS-8A/SS-8B/SW-7: In Situ Treatment
SS-10/SW-9: Removal/Treatment/Disposal

Table GA2-4. Cost Summary for 116-DR-9 Retention Basin.

Cost Element		SS-4	SS-10
ANA: Offsite Analytical Services			
ANA:02	Monitoring, Sampling & Analysis	896,730	2,791,230
SUB: Fixed Price Contractor			
SUB:01	Mobilization & Preparatory	98,320	86,895
SUB:02	Monitoring, Sampling & Analysis	655,060	1,687,645
SUB:08	Solids Collection & Containment	1,488,360	2,701,331
SUB:13	Physical Treatment	-	24,631,614
SUB:14	Thermal Treatment	-	-
SUB:15	Stabilization/Fixation	-	-
SUB:18	Disposal (Other than Commercial)	42,082,870	23,978,104
SUB:20	Site Restoration	5,429,140	4,582,906
SUB:21	Demobilization	19,930	17,686
ERC: Environmental Restoration Contractor			
ERC:02	Monitoring, Sampling & Analysis	1,138,810	3,252,496
ERC:08	Solids Collection & Containment	117,830	367,196
Subcontractor Materials Procurement Rate		497,740	576,862
Project Management/Construction Management		7,729,210	9,282,410
General & Administration/Common Support Pool		15,110,600	18,147,112
Contingency		27,095,250	34,078,290
Total		102,359,830	126,181,775
Capital		102,359,830	101,704,269
Annual Operations & Maintenance		0	7,649,221
Present Worth		95,988,999	113,522,862

SS-3/SW-3: Containment
SS-4/SW-4: Removal/Disposal
SS-8A/SS-8B/SW-7: In Situ Treatment
SS-10/SW-9: Removal/Treatment/Disposal

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Table GA2-5. Cost Summary for 116-DR-1 and 116-DR-2 Process Effluent Trenches.

Cost Element		SS-4	SS-8A	SS-10
ANA: Offsite Analytical Services				
ANA:02	Monitoring, Sampling & Analysis	239,970	-	454,680
SUB: Fixed Price Contractor				
SUB:01	Mobilization & Preparatory	60,360	58,540	66,990
SUB:02	Monitoring, Sampling & Analysis	182,380	78,290	252,650
SUB:08	Solids Collection & Containment	390,200	204,620	444,290
SUB:13	Physical Treatment	-	-	3,646,000
SUB:14	Thermal Treatment	-	-	-
SUB:15	Stabilization/Fixation	-	23,132,550	-
SUB:18	Disposal (Other than Commercial)	4,691,150	-	2,166,970
SUB:20	Site Restoration	892,390	508,880	676,730
SUB:21	Demobilization	14,910	15,040	15,100
ERC: Environmental Restoration Contractor				
ERC:02	Monitoring, Sampling & Analysis	325,010	1,843,970	510,700
ERC:08	Solids Collection & Containmen	33,410	302,730	50,650
Subcontractor Materials Procurement Rate		454,890	1,751,850	530,620
Project Management/Construction Management		1,056,710	4,184,470	1,254,110
General & Administration/Common Support Pool		2,065,860	8,180,640	2,451,780
Contingency		3,538,470	13,688,940	4,632,870
Total		13,945,720	53,950,510	17,154,130
Capital		13,945,720	30,952,940	13,669,340
Annual Operations & Maintenance		0	7,418,571	3,484,790
Present Worth		13,284,777	48,791,225	16,347,588

SS-3/SW-3: Containment SS-4/SW-4: Removal/Disposal
SS-10/SW-9: Removal/Treatment/Disposal SS-8A/SS-8B/SW-7: In Situ Treatment

Table GA2-6. Cost Summary for 107-D/DR Sludge Trench No. 1.

Cost Element		SS-4	SS-8A	SS-10
ANA: Offsite Analytical Services				
ANA:02	Monitoring, Sampling & Analysis	54,730	-	84,200
SUB: Fixed Price Contractor				
SUB:01	Mobilization & Preparatory	53,010	50,910	58,770
SUB:02	Monitoring, Sampling & Analysis	20,430	8,990	27,260
SUB:08	Solids Collection & Containment	45,340	26,980	50,180
SUB:13	Physical Treatment	-	-	428,840
SUB:14	Thermal Treatment	-	-	-
SUB:15	Stabilization/Fixation	-	6,200	-
SUB:18	Disposal (Other than Commercial)	463,360	-	262,490
SUB:20	Site Restoration	127,430	-	109,500
SUB:21	Demobilization	13,910	13,970	13,890
ERC: Environmental Restoration Contractor				
ERC:02	Monitoring, Sampling & Analysis	56,460	200,060	98,800
ERC:08	Solids Collection & Containment	3,870	30,810	8,440
Subcontractor Materials Procurement Rate		52,810	186,990	69,420
Project Management/Construction Management		125,490	446,900	169,140
General & Administration/Common Support Pool		245,340	873,700	330,660
Contingency		429,140	1,461,980	633,290
Total		1,691,310	5,761,940	2,344,870
Capital		1,691,310	3,526,040	2,076,040
Annual Operations & Maintenance		0	2,235,900	268,830
Present Worth		1,613,327	5,494,069	2,242,807

SS-3/SW-3: Containment
SS-4/SW-4: Removal/Disposal
SS-8A/SS-8B/SW-7: In Situ Treatment
SS-10/SW-9: Removal/Treatment/Disposal

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Table GA2-7. Cost Summary for 107-D/DR Sludge Trench No. 2.

Cost Element		SS-4	SS-8A	SS-10
ANA: Offsite Analytical Services				
ANA:02	Monitoring, Sampling & Analysis	54,730	-	84,200
SUB: Fixed Price Contractor				
SUB:01	Mobilization & Preparatory	52,930	50,880	58,720
SUB:02	Monitoring, Sampling & Analysis	22,070	10,370	29,110
SUB:08	Solids Collection & Containment	49,220	30,350	54,230
SUB:13	Physical Treatment	-	-	436,620
SUB:14	Thermal Treatment	-	-	-
SUB:15	Stabilization/Fixation	-	2,425,230	-
SUB:18	Disposal (Other than Commercial)	476,830	-	270,280
SUB:20	Site Restoration	132,560	93,660	114,200
SUB:21	Demobilization	13,890	13,960	13,870
ERC: Environmental Restoration Contractor				
ERC:02	Monitoring, Sampling & Analysis	58,900	205,630	101,880
ERC:08	Solids Collection & Containment	4,220	31,650	8,790
Subcontractor Materials Procurement Rate		54,570	191,580	71,320
Project Management/Construction Management		129,780	458,000	173,850
General & Administration/Common Support Pool		253,710	895,380	339,880
Contingency		443,160	1,498,270	650,070
Total		1,746,550	5,904,950	2,407,030
Capital		1,746,550	3,614,830	2,130,290
Annual Operations & Maintenance		0	2,290,120	276,740
Present Worth		1,665,934	5,630,268	2,302,000

SS-3/SW-3: Containment
SS-4/SW-4: Removal/Disposal
SS-8A/SS-8B/SW-7: In Situ Treatment
SS-10/SW-9: Removal/Treatment/Disposal

Table GA2-8. Cost Summary for 107-D/DR Sludge Trench No. 3.

Cost Element		SS-4	SS-8A	SS-10
ANA: Offsite Analytical Services				
ANA:02	Monitoring, Sampling & Analysis	54,730	-	84,200
SUB: Fixed Price Contractor				
SUB:01	Mobilization & Preparatory	52,970	50,840	58,720
SUB:02	Monitoring, Sampling & Analysis	21,420	9,810	28,360
SUB:08	Solids Collection & Containment	47,670	28,980	52,600
SUB:13	Physical Treatment	-	-	433,300
SUB:14	Thermal Treatment	-	-	-
SUB:15	Stabilization/Fixation	-	2,402,630	-
SUB:18	Disposal (Other than Commercial)	471,410	-	267,040
SUB:20	Site Restoration	130,520	91,920	112,280
SUB:21	Demobilization	13,900	13,950	13,880
ERC: Environmental Restoration Contractor				
ERC:02	Monitoring, Sampling & Analysis	56,460	203,770	101,290
ERC:08	Solids Collection & Containment	3,870	31,370	8,790
Subcontractor Materials Procurement Rate		53,870	189,660	70,530
Project Management/Construction Management		127,810	453,440	172,020
General & Administration/Common Support Pool		249,870	886,470	336,300
Contingency		436,730	1,483,370	643,550
Total		1,721,210	5,846,220	2,382,880
Capital		1,721,210	3,578,700	2,109,470
Annual Operations & Maintenance		0	2,267,520	273,410
Present Worth		1,641,802	5,574,331	2,279,000
SS-3/SW-3: Containment SS-4/SW-4: Removal/Disposal SS-8A/SS-8B/SW-7: In Situ Treatment SS-10/SW-9: Removal/Treatment/Disposal				

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Table GA2-9. Cost Summary for 107-D/DR Sludge Trench No. 4.

Cost Element		SS-4	SS-8A	SS-10
ANA: Offsite Analytical Services				
ANA:02	Monitoring, Sampling & Analysis	46,310	-	71,570
SUB: Fixed Price Contractor				
SUB:01	Mobilization & Preparatory	52,020	49,910	57,840
SUB:02	Monitoring, Sampling & Analysis	15,440	7,170	20,250
SUB:08	Solids Collection & Containment	34,990	22,170	38,440
SUB:13	Physical Treatment	-	-	348,180
SUB:14	Thermal Treatment	-	-	-
SUB:15	Stabilization/Fixation	-	1,699,930	-
SUB:18	Disposal (Other than Commercial)	323,760	-	183,620
SUB:20	Site Restoration	99,060	72,610	86,610
SUB:21	Demobilization	13,760	13,820	13,760
ERC: Environmental Restoration Contractor				
ERC:02	Monitoring, Sampling & Analysis	45,950	144,670	83,880
ERC:08	Solids Collection & Containment	2,810	21,660	7,030
Subcontractor Maintenance Procurement Rate		39,350	136,190	54,660
Project Management/Construction Management		94,070	325,220	134,140
General & Administration/Common Support Pool		183,920	635,810	262,250
Contingency		323,500	1,063,920	504,020
Total		1,274,960	4,193,090	1,866,250
Capital		1,274,960	2,628,510	1,678,190
Annual Operations &Maintenance		0	1,564,580	188,060
Present Worth		1,216,748	3,999,853	1,786,929

SS-3/SW-3: Containment
SS-4/SW-4: Removal/Disposal
SS-8A/SS-8B/SW-7: In Situ Treatment
SS-10/SW-9: Removal/Treatment/Disposal

Table GA2-10. Cost Summary for 107-D/DR Sludge Trench No. 5.

Cost Element		SS-4	SS-8A	SS-10
ANA: Offsite Analytical Services				
ANA:02	Monitoring, Sampling & Analysis	50,520	-	75,780
SUB: Fixed Price Contractor				
SUB:01	Mobilization & Preparatory	52,150	50,000	57,990
SUB:02	Monitoring, Sampling & Analysis	12,520	3,490	17,900
SUB:08	Solids Collection & Containment	27,500	13,360	31,340
SUB:13	Physical Treatment	-	-	367,550
SUB:14	Thermal Treatment	-	-	-
SUB:15	Stabilization/Fixation	-	1,912,170	-
SUB:18	Disposal (Other than Commercial)	356,970	-	202,430
SUB:20	Site Restoration	95,690	66,420	82,010
SUB:21	Demobilization	13,780	13,830	13,780
ERC: Environmental Restoration Contractor				
ERC:02	Monitoring, Sampling & Analysis	41,880	160,330	83,520
ERC:08	Solids Collection & Containment	2,110	24,480	7,030
Subcontractor Maintenance Procurement Rates		40,780	150,330	56,430
Project Management/Construction Management		96,510	359,160	138,000
General & Administration/Common Support Pool		188,670	702,160	269,790
Contingency		332,880	1,174,950	519,310
Total		1,311,940	4,630,670	1,922,860
Capital		1,311,940	2,853,640	1,715,420
Annual Operations & Maintenance		0	1,777,030	207,440
Present Worth		1,251,974	4,416,602	1,840,851

SS-3/SW-3: Containment
SS-4/SW-4: Removal/Disposal
SS-8A/SS-8B/SW-7: In Situ Treatment
SS-10/SW-9: Removal/Treatment/Disposal

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Table GA2-11. Cost Summary for 116-D-1A Fuel Storage Basin Trench.

Cost Element		SS-4	SS-10
ANA: Offsite Analytical Services			
ANA:02	Monitoring, Sampling & Analysis	134,720	202,080
SUB: Fixed Price Contractor			
SUB:01	Mobilization & Preparatory	48,220	54,020
SUB:02	Monitoring, Sampling & Analysis	90,500	109,850
SUB:08	Solids Collection & Containment	197,440	210,690
SUB:13	Physical Treatment	-	1,110,490
SUB:14	Thermal Treatment	-	-
SUB:15	Stabilization/Fixation	-	-
SUB:18	Disposal (Other than Commercial)	1,296,360	591,070
SUB:20	Site Restoration	327,910	265,790
SUB:21	Demobilization	13,220	13,210
ERC: Environmental Restoration Contractor			
ERC:02	Monitoring, Sampling & Analysis	195,830	261,770
ERC:08	Solids Collection & Containment	16,880	21,450
Subcontractor Maintenance Procurement Rates		144,080	171,920
Project Management/Construction Management		349,570	421,540
General & Administration/Common Support Poo		683,410	824,110
Contingency		1,189,370	1,575,460
Total		4,687,520	5,833,480
Capital		4,687,520	4,883,100
Annual Operations & Maintenance		0	950,380
Present Worth		4,466,689	5,565,137
SS-3/SW-3: Containment SS-4/SW-4: Removal/Disposal SS-8A/SS-8B/SW-7: In Situ Treatment SS-10/SW-9: Removal/Treatment/Disposal			

Table GA2-12. Cost Summary for 116-D-1B Fuel Storage Basin Trench.

Cost Element		SS-4	SS-10
ANA: Offsite Analytical Services			
ANA:02	Monitoring, Sampling & Analysis	67,360	101,040
SUB: Fixed Price Contractor			
SUB:01	Mobilization & Preparatory	52,940	58,820
SUB:02	Monitoring, Sampling & Analysis	22,680	31,090
SUB:08	Solids Collection & Containment	47,840	53,780
SUB:13	Physical Treatment	-	569,520
SUB:14	Thermal Treatment	-	-
SUB:15	Stabilization/Fixation	-	-
SUB:18	Disposal (Other than Commercial)	557,520	254,750
SUB:20	Site Restoration	136,920	110,390
SUB:21	Demobilization	13,890	13,900
ERC: Environmental Restoration Contractor			
ERC:02	Monitoring, Sampling & Analysis	66,060	113,390
ERC:08	Solids Collection & Containment	3,870	9,140
Subcontractor Materials Procurement Rate		60,720	79,730
Project Management/Construction Management		144,370	194,180
General & Administration/Common Support Pool		282,230	379,620
Contingency		495,170	728,660
Total		1,951,570	2,698,020
Capital		1,951,570	2,288,570
Annual Operations & Maintenance		0	409,450
Present Worth		1,861,172	2,579,151

SS-3/SW-3: Containment
SS-4/SW-4: Removal/Disposal
SS-8A/SS-8B/SW-7: In Situ Treatment
SS-10/SW-9: Removal/Treatment/Disposal

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Table GA2-13. Cost Summary for 116-D-2A Pluto Crib.

Cost Element		SS-4	SS-8A	SS-10
ANA: Offsite Analytical Services				
ANA:02	Monitoring, Sampling & Analysis	16,840	-	29,470
SUB: Fixed Price Contractor				
SUB:01	Mobilization & Preparatory	53,120	45,040	53,600
SUB:02	Monitoring, Sampling & Analysis	1,540	960	1,670
SUB:08	Solids Collection & Containment	6,590	6,040	7,560
SUB:13	Physical Treatment	-	-	171,110
SUB:14	Thermal Treatment	-	-	-
SUB:15	Stabilization/Fixation	-	225,280	-
SUB:18	Disposal (Other than Commercial)	16,960	-	10,090
SUB:20	Site Restoration	19,870	18,640	19,480
SUB:21	Demobilization	13,110	13,120	13,210
ERC: Environmental Restoration Contractor				
ERC:02	Monitoring, Sampling & Analysis	10,030	22,110	41,410
ERC:08	Solids Collection & Containment	280	1,550	3,870
Subcontractor Materials Procurement Rate		8,120	22,560	20,200
Project Management/Construction Management		19,440	53,300	51,330
General & Administration/Common Support Pool		38,010	104,190	100,350
Contingency		73,410	174,350	193,640
Total		277,310	687,150	716,990
Capital		277,310	597,530	707,750
Annual Operations & Maintenance		0	89,620	9,240
Present Worth		266,639	660,573	692,246

SS-3/SW-3: Containment
SS-4/SW-4: Removal/Disposal
SS-8A/SS-8B/SW-7: In Situ Treatment
SS-10/SW-9: Removal/Treatment/Disposal

Table GA2-14. Cost Summary for 100 DR Pipelines.

Cost Element		SS-3	SS-4	SS-8B
ANA: Offsite Analytical Services				
ANA:02	Monitoring, Sampling & Analysis	-	218,920	-
SUB: Fixed Price Contractor				
SUB:01	Mobilization & Preparatory	27,900	48,030	17,580
SUB:02	Monitoring, Sampling & Analysis	-	353,030	-
SUB:08	Solids Collection & Containment	13,414,400	1,190,940	1,786,770
SUB:13	Physical Treatment	-	-	-
SUB:14	Thermal Treatment	-	-	-
SUB:15	Stabilization/Fixation	-	-	-
SUB:18	Disposal (Other than Commercial)	-	169,140	-
SUB:20	Site Restoration	1,539,900	1,652,420	-
SUB:21	Demobilization	8,680	11,160	8,630
ERC: Environmental Restoration Contractor				
ERC:02	Monitoring, Sampling & Analysis	583,020	621,440	68,580
ERC:08	Solids Collection & Containment	14,250	87,930	5,450
Subcontractor Maintenance Procurement Rates		1,094,330	250,000	18,130
Project Management/Construction Management		2,502,370	657,610	285,770
General & Administration/Common Support Pool		4,892,140	1,285,640	558,680
Contingency		8,186,180	2,487,580	934,860
Total		32,263,170	9,033,850	3,684,470
Capital		32,263,170	9,033,850	3,684,470
Annual Operations & Maintenance		670,720	0	0
Present Worth		38,143,751	8,606,125	3,509,926

SS-3/SW-3: Containment
SS-4/SW-4: Removal/Disposal
SS-8A/SS-8B/SW-7: In Situ Treatment
SS-10/SW-9: Removal/Treatment/Disposal

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Table GA2-15. Cost Summary for 118-D-4A Burial Ground.

Cost Element		SW-3	SW-4	SW-7	SW-9
ANA: Offsite Analytical Services					
ANA:02	Monitoring, Sampling & Analysis	-	12,630	-	12,630
SUB: Fixed Price Contractor					
SUB:01	Mobilization & Preparatory	50190	53490	75820	60410
SUB:02	Monitoring, Sampling & Analysis	-	30430	-	30420
SUB:08	Solids Collection & Containment	447140	75620	500890	75610
SUB:13	Physical Treatment	-	-	-	87220
SUB:14	Thermal Treatment	-	-	-	278830
SUB:15	Stabilization/Fixation	-	-	-	-
SUB:18	Disposal (Other than Commercial)	-	767640	-	446340
SUB:20	Site Restoration	49460	173970	49490	172910
SUB:21	Demobilization	14,030	14,010	14,040	14,010
ERC: Environmental Restoration Contractor					
ERC:02	Monitoring, Sampling & Analysis	28220	52580	50490	66960
ERC:08	Solids Collection & Containment	740	6330	3170	11400
Subcontractor Materials Procurement Rate		40940	81410	46740	85100
Project Management/Construction Management		94610	188320	111090	199380
General & Administration/Common Support Pool		184960	368170	217190	389790
Contingency		309490	675100	363430	714480
Total		1219770	2499700	1432340	2645500
Capital		1219770	2499700	1432340	2508630
Annual Operations & Maintenance		22357	0	25044	136870
Present Worth		1,451,296	2,383,260	1,689,485	2,532,877

SS-3/SW-3: Containment
SS-4/SW-4: Removal/Disposal
SS-8A/SS-8B/SW-7: In Situ Treatment
SS-10/SW-9: Removal/Treatment/Disposal

Table GA2-16. Cost Summary for 118-D-4B Burial Ground.

Cost Element		SW-3	SW-4	SW-7	SW-9
ANA: Offsite Analytical Services					
ANA:02	Monitoring, Sampling & Analysis	-	12,630	-	12,630
SUB: Fixed Price Contractor					
SUB:01	Mobilization & Preparatory	46,280	48,790	59,100	55,690
SUB:02	Monitoring, Sampling & Analysis	-	3,980	-	3,980
SUB:08	Solids Collection & Containment	231,780	12,990	256,110	12,980
SUB:13	Physical Treatment	-	-	-	43,790
SUB:14	Thermal Treatment	-	-	-	208,920
SUB:15	Stabilization/Fixation	-	-	-	-
SUB:18	Disposal (Other than Commercial)	-	63,470	-	36,990
SUB:20	Site Restoration	27,840	37,150	27,860	37,040
SUB:21	Demobilization	13,470	13,360	13,480	13,350
ERC: Environmental Restoration Contractor					
ERC:02	Monitoring, Sampling & Analysis	19,390	16,600	37,960	21,420
ERC:08	Solids Collection & Containment	490	1,060	2,530	1,900
Subcontractor Materials Procurement Rate		23,310	13,120	26,030	30,130
Project Management/Construction Management		54,380	31,580	63,460	69,930
General & Administration/Common Support Pool		106,320	61,730	124,060	136,710
Contingency		177,910	117,090	207,600	253,620
Total		701,190	433,530	818,180	939,070
Capital		701,190	433,530	818,180	915,930
Annual Operations & Maintenance		12,618	0	14,001	23,140
Present Worth		832,107	415,216	961,905	907,466

SS-3/SW-3: Containment
SS-4/SW-4: Removal/Disposal
SS-8A/SS-8B/SW-7: In Situ Treatment
SS-10/SW-9: Removal/Treatment/Disposal

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Table GA2-17. Cost Summary for 118-D-18 Burial Ground.

Cost Element		SW-3	SW-4	SW-7	SW-9
ANA: Offsite Analytical Services					
ANA:02	Monitoring, Sampling & Analysis	-	12,630	-	12,630
SUB: Fixed Price Contractor					
SUB:01	Mobilization & Preparatory	46,710	48,630	59,570	55,560
SUB:02	Monitoring, Sampling & Analysis	-	6,090	-	6,090
SUB:08	Solids Collection & Containment	252,360	17,970	280,020	17,970
SUB:13	Physical Treatment	-	-	-	46,700
SUB:14	Thermal Treatment	-	-	-	213,630
SUB:15	Stabilization/Fixation	-	-	-	-
SUB:18	Disposal (Other than Commercial)	-	110,720		64,390
SUB:20	Site Restoration	29,900	45,760	29,940	45,610
SUB:21	Demobilization	13,530	13,330	13,550	13,330
ERC: Environmental Restoration Contractor					
ERC:02	Monitoring, Sampling & Analysis	19,970	19,040	40,390	24,490
ERC:08	Solids Collection & Containment	490	1,410	2,740	2,530
Subcontractor Materials Procurement Rate		25,000	17,700	27,960	33,820
Project Management/Construction Management		58,200	42,100	68,130	78,620
General & Administration/Common Support Pool		113,770	82,300	133,190	153,700
Contingency		190,380	154,530	222,870	284,560
Total		750,320	572,190	878,370	1,053,630
Capital		750,320	572,190	878,370	1,022,860
Annual Operations & Maintenance		11,589	0	12,806	30,770
Present Worth		865,700	547,269	1,003,895	1,016,567

SS-3/SW-3: Containment
SS-4/SW-4: Removal/Disposal
SS-8A/SS-8B/SW-7: In Situ Treatment
SS-10/SW-9: Removal/Treatment/Disposal